PB-215 045

# REPORT FOR CONSULTATION ON THE AIR QUALITY CONTROL REGION FOR THE NEW JERSEY-NEW YORK-CONNECTICUT INTERSTATE AREA

National Air Pollution Control Administration
Washington, D. C.

30 August 1968

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# REPORT FOR CONSULTATION ON THE AIR QUALITY CONTROL REGION FOR THE NEW JERSEY-NEW YORK-CONNECTICUT INTEPSTATE AREA

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
U. S. PUBLIC HEALTH SERVICE

NATIONAL TECHNICAL
INFORMATION SERVICE

# REPORT FOR CONSULTATION ON THE

# AIR QUALITY CONTROL REGION FOR THE

# NEW JERSEY-NEW YORK-CONNECTICUT INTERSTATE AREA

Details of illustrations in
this document may be better
studied on microfiche.

Department of Health, Education, and Welfare
U.S. Public Health Service
National Air Pollution Control Administration
August 30, 1968

I

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## PREFACE

The Secretary, Department of Health, Education, and Welfare, is directed by the Air Quality Act of 1967 to designate "air quality control regions" to provide a basis for the establishment of air quality standards and the implementation of air quality control programs. In addition to listing the major factors to be considered in the development of region boundaries, the Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities.

The National Air Pollution Control Administration, DHEW, has conducted a study of the New Jersey-New York-Connecticut urban area, the results of which are presented in this report. The Region* boundaries proposed in this report reflect consideration of all available and pertinent data; however, the boundaries remain subject to revision suggested by consultation with State and local authorities. Formal designation will be withheld pending the outcome of that meeting. This report is intended to serve as the starting point for the consultation.

The Administration is appreciative of assistance received either directly during the course of this study or indirectly during previous activities in the New York City Metropolitan Area from the official air pollution agencies of the City of New York and the States of New York, New Jersey, and Connecticut. Useful data was also supplied by

*For the purposes of this report, the word region, when capitalized, will refer to the New Jersey-New York-Connecticut Interstate Air Quality Control Region. When not capitalized, unless otherwise noted, it will refer to air quality control regions in general.

the Tri-State Transportation Commission, the Regional Plar Association, and the New York City Council on Economic Education.

# INTRODUCTION

> "For the purpose of establishing ambient air quality standards pursuant to section 108, and for administrative and other purposes, the Secretary, after consultation with appropriate State and local authorities shall, to the extent feasible, within 18 months after the date of enactment of the Air Quality Act of 1967 designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may from time to time thereafter, as he determines necessary to protect the public health and welfare and after consultation with appropriate State and local authorities, revise the designation of such regions and designate additional air quality control regions. The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."
>
> Section 107 (a) (2), Air Quality Act of 1967

## THE AIR QUALITY ACT

Air pollution in most of the Nation's urban areas is a regional problem. Consistent with the problem, the solution demands coordinated regional planning and regional effort. Yet, with few exceptions, such coordinated efforts are notable by their absence in the Nation's urban complexes.

Beginning with the Section quoted above, in which the Secretary is required to designate air quality control regions, the Air Quality Act presents an approach to air pollution control involving closely coordinated efforts by Federal, State, and local governments, as shown in Figure 1. After the Secretary has (1) designated regions, (2) published air quality criteria, and (3) published corresponding documents

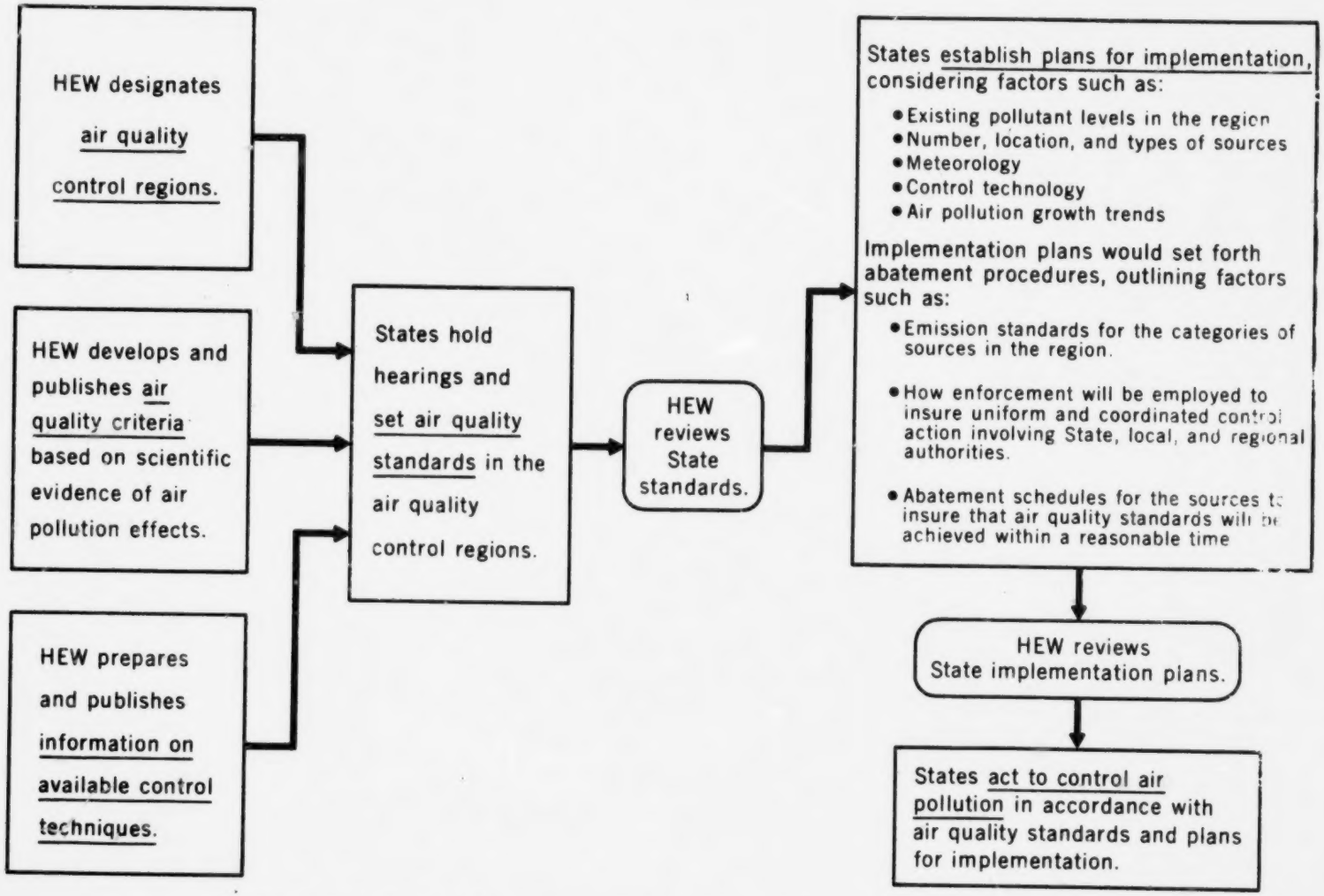

HEW designates air quality control regions.
HEW develops and publishes air quality criteria based on scientific evidence of air pollution effects.
HEW prepares and publishes information on available control techniques.
States hold hearings and set air quality standards in the air quality control regions.
HEW reviews State standards.
States establish plans for implementation, considering factors such as:
• Existing pollutant levels in the region
• Number, location, and types of sources
• Meteorology
• Control technology
• Air pollution growth trends
Implementation plans would set forth abatement procedures, outlining factors such as:
• Emission standards for the categories of sources in the region.
• How enforcement will be employed to insure uniform and coordinated control action involving State, local, and regional authorities.
• Abatement schedules for the sources to insure that air quality standards will be achieved within a reasonable time
HEW reviews State implementation plans.
States act to control air pollution in accordance with air quality standards and plans for implementation.

Figure 1. Flow diagram for State action to control air pollution on a regional basis.

on control technology and associated costs, the State(s) must file with the Secretary, HEW, within 90 days a letter of intent, indicating the State(s) will adopt within 180 days ambient air quality standards for the pollutants covered by the criteria documents, and, within an additional 180 days plans for the implementation, maintenance, and enforcement of those standards adopted for designated air quality control regions.

The new Federal legislation provides for a regional attack on the problem and, at the same time, provides latitude for these regional efforts. While the Secretary has approval authority, the State or States involved in a designated region assume responsibility for developing standards and an implementation plan which includes administrative procedures for abatement and control. It is conceivable that an informal cooperative arrangement with proper safeguards will be adequate in some regions, whereas in others, more formal arrangements, such as interstate compacts, may be selected. The objective in each instance will be to provide effective mechanisms for control on a regional basis.

## PROCEDURE IN DESIGNATION OF REGIONS

Figure 2 illustrates the procedure used by the Administration in the designation of an air quality control region. A preliminary delineation of the region is developed by bringing together two essentially separate studies -- the "Engineering Evaluation" and the research into "Urban Factors." To be successful, an air quality control region must include jurisdictions capable of administering a

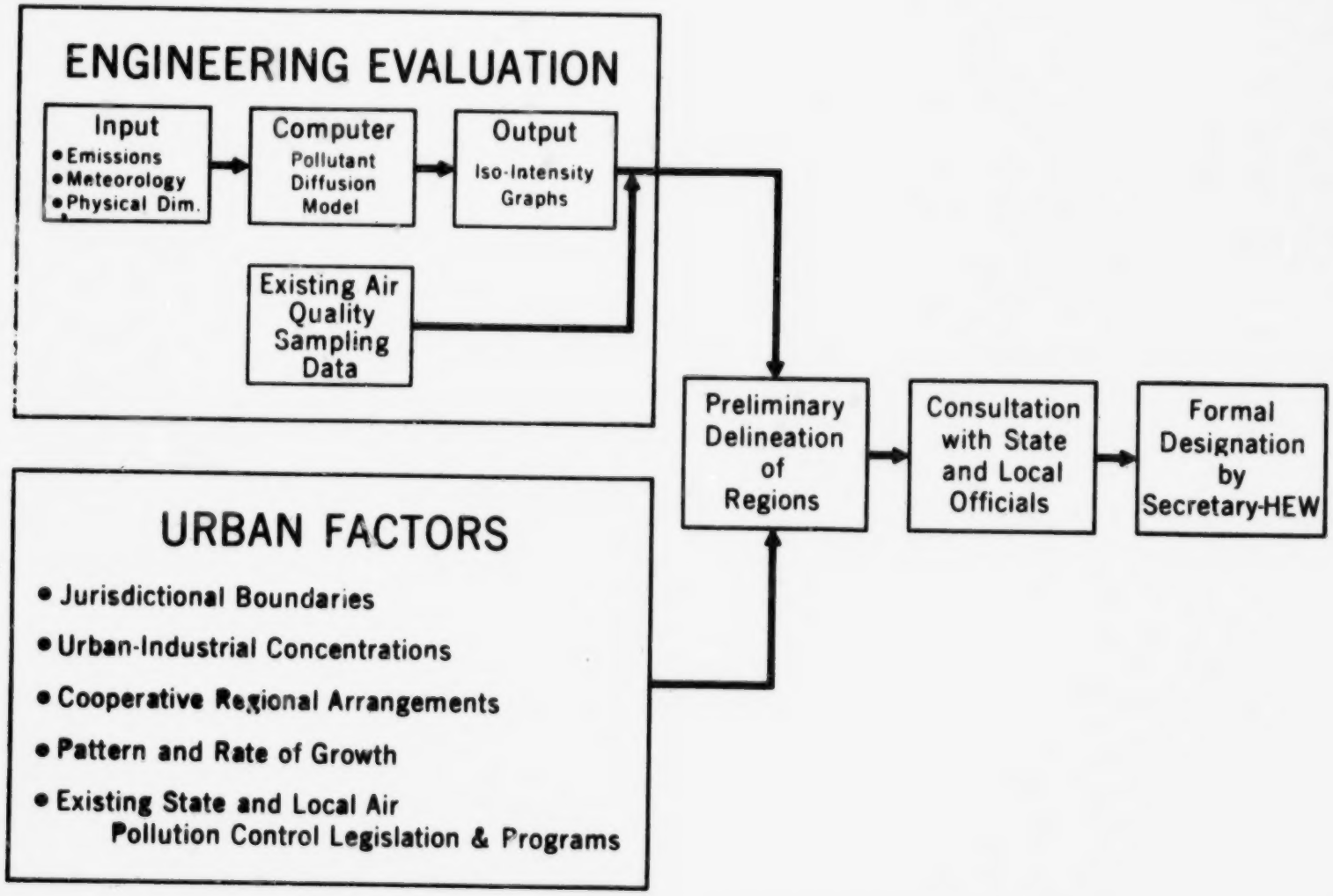



Figure 2. Flow diagram for the designation of air quality control regions.

coordinated control effort, and the combination must include an area large enough for a comprehensive attack on the problem of air pollution. The study of urban factors provides insight on the nature of the jurisdictions and the engineering evaluation provides an indication of the geographical extent of the problem.

For air pollution that is truly regional in scope, air quality control regions must be defined so as to include the majority of the pollution sources contributing to the problem in an urban area and must be extensive enough to encompass the majority of the population and property affected by pollution emanating from the sources within the area. This requirement could be generally satisfied by individual evaluation of the major factors -- the location, nature, and quantity of pollutant emissions; present and projected patterns of urban development; existing air quality levels; and prevailing air pollution meteorology. While separate consideration of these individual factors provides useful insight on the nature of an urban area, it does not provide a direct or dynamic indication of the extent of influence of sources in an urban complex.

To supplement available air quality data, a constantly-evolving technique referred to as diffusion modeling is employed. Diffusion modeling is a semi-dynamic process in which the air quality levels at selected locations are estimated by calculating and adding together the weighted contribution from each of the sources, or groups of sources, within the area under consideration. As with most mathematical simulation approaches, the calculations are repetitive and

time-consuming, and so they are routinely carried out with the aid of a computer.

These steps are outlined under "Engineering Evaluation" in Figure 2, and the box labeled "Input" describes the information required to apply the diffusion model. This information consists of data on the nature and quantity of the pollutants being released and the physical location of the sources, the average depth of air available for mixing and dilution, the frequency of various wind velocities (direction and speed) and the physical dimensions and topography of the urban area under study. The necessary calculations are made with this information in the next step, labeled "Computer." The result or "Output" of the diffusion model approach is the estimated pattern of air quality levels caused by the sources of a given pollutant within the area. Because of the experimental nature of diffusion modeling, the results are interpreted as theoretical. After making necessary empirical adjustments, "iso-intensity" lines (which will usually be closed, irregularly-shaped contours of equal concentrations) can be developed and presented in graphic or map form. These graphs help establish general geographical limits for the extent of influence of pollution sources in a given area and, thus, serve as a guide to the necessary size of the air quality control region.

The term "Urban Factors" encompasses all considerations of a non-engineering nature. Several examples are listed in Figure 2, but many other factors are covered. The existence and extent of Standard Metropolitan Statistical Areas and Planning Areas of the

Department of Housing and Urban Development are examples of some of the additional factors that influence the final result in a given region. Based on the concept that, with some possible exceptions, it is inadvisable to consider the inclusion of only part of a county in a region, the study of urban factors results in a preliminary region made up of the most reasonable combination of counties consistent with the engineering evaluation.

The recommendation as to size and shape of the air quality control region for the New Jersey-New York-Connecticut area and the supporting documentation make up the body of this report. The report itself is meant to serve as the background document for the formal consultation with the appropriate State and local authorities, and based on the consultation, the Region boundaries proposed herein are subject to revision within the discretion of the Secretary, HEW. Following the consultation, the Secretary will publish the final determination of the Region in the Federal Register and will notify Governors of New York, New Jersey, and Connecticut of his official designation.

## THE PROPOSED REGION

Subject to the scheduled consultation, the Secretary, Department of Health, Education, and Welfare, proposes to designate an air quality control region for the New Jersey-New York-Connecticut interstate area, consisting of the following jurisdictions:

In the State of Connecticut
- Greenwich Township
- Stamford Township
- Darien Township
- New Canaan Township
- Norwalk Township
- Wilton Township
- Weston Township
- Westport Township
- Fairfield Township
- Easton Township
- Bridgeport Township
- Stratford Township
- Trumbull Township
- Monroe Township
- Ridgefield Township
- Redding Township
- Newtown Township
- Bethel Township
- Danbury Township
- Brookfield Township
- New Fairfield Township

In the State of New York
- Kings County
- Bronx County
- Nassau County
- New York County
- Queens County
- Richmond County
- Westchester County
- Rockland County

In the State of New Jersey
- Bergen County
- Essex County
- Hudson County
- Middlesex County
- Monmouth County
- Morris County
- Passaic County
- Somerset County
- Union County

As so proposed, the New Jersey-New York-Connecticut Interstate Air Quality Control Region would consist of the territorial area encompassed by the outermost boundaries of the above jurisdictions and the territorial area of all municipalities located therein and as defined in Section 302 (f) of the Clean Air Act, 42 U.S.C. 1857h (f). The proposed region is illustrated in Figure 3.

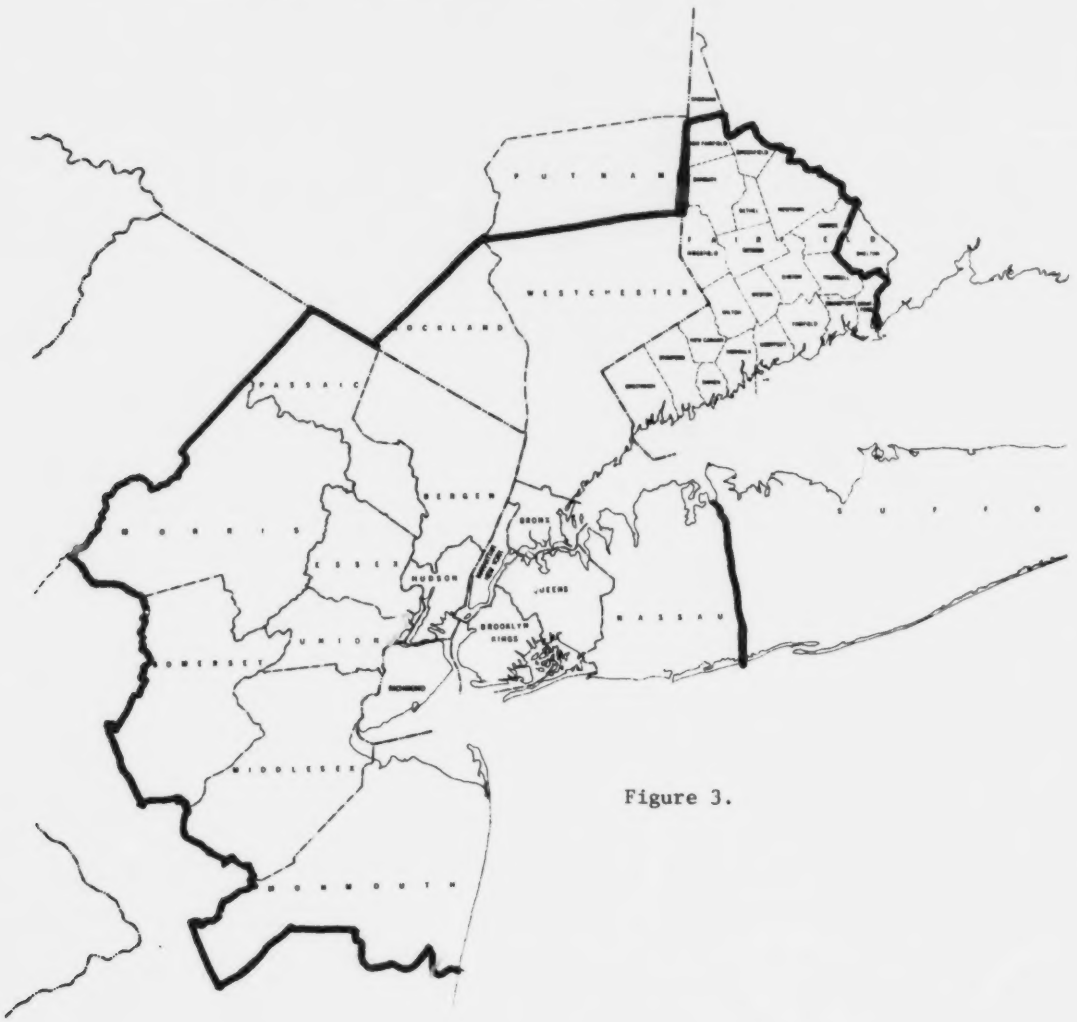



Figure 3.

## DISCUSSION OF PROPOSAL

There are three major conditions to be met in designating an air quality control region. First, the boundaries should encompass most pollution sources as well as most people and property affected by those sources. Second, the boundaries should encompass those locations where industrial and residential development will create significant air pollution problems in the near future. Third, the boundaries should be chosen in a way which is compatible with and even fosters unified and cooperative governmental administration of the air resource throughout the region.

The Evaluation of Engineering Factors (discussion beginning on page 25) was directed toward the first of these conditions and the Evaluation of Urban Factors (page 13), the other two. A combination of eight New York and nine New Jersey counties and twenty-one Connecticut townships was common to all three of the stated conditions, leading to the proposal made herein.

Taken separately, some of the factors considered suggested the inclusion of a few jurisdictions bordering those proposed here. As discussed in the Evaluation of Engineering Factors, the major impact of pollution sources located <u>within</u> the proposed Region is also within the Region, with the following exceptions: (1) known or theoretically predicted $SO_X$ levels of concern extend into small portions of Mercer County, New Jersey, and Suffolk and Orange Counties, New York; and (2) known or theoretically predicted CO levels of concern encompass all of Putnam County and part of Suffolk, Orange, and Dutchess Counties in

New York, and New Haven and Litchfield Counties in Connecticut. Yet, the Evaluation of Urban Factors provided sufficient reason to rule out serious consideration of all but one of the above-named jurisdictions, the exception being Suffolk County, New York. Orange, Putnam, and Dutchess Counties in New York and Litchfield County in Connecticut are essentially non-urban areas. Mercer and New Haven have substantial populations and industrial activities but they are more intimately involved in other centers of regional activity.

With respect to Suffolk County, the Evaluation of Urban Factors brought to light conflicting considerations. The majority of the county's almost one million inhabitants reside in the western portion of the county. This, together with the results of the engineering analysis strongly suggest that at least a portion of the county is as subject to inclusion in the Region as some parts of the jurisdictions proposed here. However, a decision to bring the affected portion of Suffolk County into the region, coupled with a desire to maintain the entity of whole counties, might increase the size and nature of the Region to a degree that would make a regional attack on the problem of air pollution more difficult. For this reason, Suffolk County has not been proposed for inclusion at this time. Comments received during the consultation on this proposed Region from officials of New York and of Suffolk County itself will have direct bearing on the final disposition of Suffolk County in this regard.

As is true of most efforts to draw boundaries around an area to differentiate it from its surroundings, there is always a likelihood

of boundary conditions existing or developing. In the case of air quality control regions, such a boundary condition would exist where there are sources of pollution on one side of the region boundary affecting in some real way air quality on the other side of the boundary. Relocating the boundary would only rarely provide relief from this condition (especially along the urbanized East Coast). The solution is to be found in the way in which control efforts are implemented following the designation of an air quality control region. Consonant with the basic objective of providing desirable air quality within the problem area being designated as an air quality control region, the implementation plan that follows the designation should have provisions for the control of sources located close to but beyond the region boundaries. The level of control for such sources would be a function of, among other factors, the degree to which emissions from such sources cause air quality levels to exceed the standards chosen for application within the air quality control region.

The remaining two sections of this report describe the initial evaluation of urban and engineering factors. Each is, as much as is possible, independent of the other--both with respect to subject and conclusions. As this discussion has indicated, the final proposal is based upon both studies where there was agreement between them and upon the balancing of the two where the two had differing conclusions. The Region proposed herein is considered on the whole to be the most cohesive and yet inclusive area within which an effective regional effort can be mounted to prevent and control air pollution in the three-State urban area surrounding New York City.

## EVALUATION OF URBAN FACTORS

The New Jersey-New York-Connecticut interstate area constitutes the largest urban center in this Nation by almost any criteria. It also lies at the heart of the so-called megalopolis which stretches from Portland, Maine, to Norfolk, Virginia. This region will, therefore, be one of the most important air quality control regions designated.

A large number of jurisdictions were considered for inclusion in the Region. Jurisdictions participating in the New York-New Jersey Abatement Action, conducted recently by this Administration, were taken as the natural core of the Region. This section of the Report presents an evaluation of the urban character of jurisdictions bordering the core area. The evaluation points toward the combination of jurisdictions thought most capable of administering a coordinated control effort.

The most significant potential addition to the 17-county* area covered by the Abatement Action is a portion of the State of Connecticut. The State of Connecticut, or specific portions of it, are intimately involved in many activities centered in and around New York City. The Department of Housing and Urban Development has designated the Tri-State Transportation Commission, which includes a portion of Connecticut, as its official planning agency for this interstate area. Perhaps most

*Kings County, Bronx County, Nassau County, New York County, Queens County, Richmond County, Westchester County, Rockland County, Bergen County, Essex County, Hudson County, Middlesex County, Monmouth County, Morris County, Passaic County, Somerset County, Union County

important, there is no clear break between the New York-New Jersey urban concentration and the heavily populated and industrialized portion of Southwestern Connecticut.

Inclusion of a portion of Connecticut gives rise to some special problems. Connecticut does not normally utilize counties as administrative units. This being the case, it is necessary to select another jurisdictional unit as the basis for Region boundaries within that State. The most obvious unit is the township; however, townships are of such limited geographic area that it seems desirable to decide upon some method of combining them into functional units when designating regions. Perhaps the most useful combination of townships currently operational are the planning regions defined by the Connecticut Development Commission. These planning regions provide a useful method of utilizing established cooperative arrangements between townships in each portion of the State.

While counties do not function as administrative units, they are used for some data-gathering purposes and serve as the basis for many informal working relationships. It, therefore, is desirable to combine planning regions so that they approximate the boundaries of Connecticut counties. The Connecticut County bordering the New York-New Jersey urban area is Fairfield County. Three planning regions--the Southwestern, Greater Bridgeport, and Housatonic Valley planning regions--include all the townships in Fairfield County with the exception of the townships of Sherman and Shelton. They do not extend beyond the borders of Fairfield County.

New Haven County, lying immediately to the East of Fairfield County, contains urban-industrial concentrations at New Haven, Waterbury, and the Derby-Ansonia area, but they are not nearly as closely tied to the New York-New Jersey urban area. Litchfield County, immediately to the North, is one of the least industrialized and most sparsely populated counties in the State. If it was decided to include portions of Connecticut beyond the borders of Fairfield County, it would be difficult to find combinations of planning regions which approximate county boundaries and at the same time, include jurisdictions that could be rationally linked to the New York-New Jersey interstate area.

Several New York counties bordering on the eight counties included in the Abatement Action area were also evaluated for inclusion in the Region. Suffolk County is the jurisdiction most similar in nature to the counties of the core area. This county has approximately one million inhabitants and had the third highest growth rate in the Nation during the last eight years.[1] The population projections in Table I indicate that this growth rate will continue through the comming years so that, by 1985, Suffolk County will probably become the third most populous county in the New York metropolitan area. Housing starts in Suffolk County, a further indication of population growth, are shown in Table II to be significantly above the rate of any other suburban county under consideration.

[1] Commercial Atlas and Marketing Guide, Chicago: Rand McNally and Company, 1968.

TABLE I.

POPULATION IN THE NEW YORK METROPOLITAN REGION 1920-1960, AND PROJECTIONS TO 1985
(IN THOUSANDS)

| | 1920 | 1930 | 1940 | 1950 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 |
|---|---|---|---|---|---|---|---|---|---|---|
| Metropolitan Region | 9,139 | 11,643 | 12,518 | 13,951 | 16,141 | 17,180 | 18,440 | 19,700 | 20,935 | 22,170 |
| New York: | 6,469 | 8,224 | 8,985 | 9,866 | 11,087 | 11,560 | 12,019 | 12,480 | 12,907 | 13,335 |
| New York City | 5,620 | 6,930 | 7,455 | 7,893 | 7,782 | 7,750 | 7,694 | 7,640 | 7,632 | 7,625 |
| Bronx | 732 | 1,265 | 1,395 | 1,451 | 1,424 | 1,400 | 1,375 | 1,350 | 1,350 | 1,350 |
| Kings | 2,018 | 2,561 | 2,698 | 2,739 | 2,627 | 2,600 | 2,549 | 2,500 | 2,475 | 2,450 |
| New York | 2,284 | 1,867 | 1,890 | 1,960 | 1,698 | 1,625 | 1,575 | 1,525 | 1,500 | 1,475 |
| Queens | 469 | 1,079 | 1,298 | 1,551 | 1,810 | 1,875 | 1,900 | 1,925 | 1,925 | 1,925 |
| Richmond | 117 | 158 | 174 | 192 | 222 | 250 | 295 | 340 | 382 | 425 |
| Other New York | 849 | 1,294 | 1,530 | 1,973 | 3,305 | 3,810 | 4,325 | 4,840 | 5,275 | 5,710 |
| Dutchess | 92 | 105 | 121 | 137 | 176 | 200 | 260 | 320 | 373 | 425 |
| Nassau | 126 | 303 | 407 | 673 | 1,300 | 1,400 | 1,499 | 1,500 | 1,525 | 1,550 |
| Orange | 120 | 130 | 140 | 152 | 184 | 205 | 278 | 350 | 445 | 540 |
| Putnam | 11 | 14 | 17 | 20 | 32 | 35 | 45 | 55 | 70 | 85 |
| Rockland | 46 | 60 | 74 | 89 | 137 | 170 | 195 | 320 | 335 | 350 |
| Suffolk | 110 | 161 | 197 | 276 | 667 | 910 | 1,103 | 1,295 | 1,477 | 1,660 |
| Westchester | 344 | 521 | 574 | 626 | 809 | 890 | 945 | 1,000 | 1,050 | 1,100 |
| New Jersey | 2,349 | 3,032 | 3,114 | 3,581 | 4,400 | 4,870 | 5,513 | 6,155 | 6,785 | 7,415 |
| Bergen | 211 | 365 | 410 | 539 | 780 | 920 | 1,009 | 1,100 | 1,150 | 1,200 |
| Essex | 652 | 835 | 837 | 907 | 924 | 940 | 950 | 960 | 955 | 950 |
| Hudson | 629 | 691 | 652 | 647 | 611 | 590 | 575 | 560 | 550 | 540 |
| Middlesex | 162 | 212 | 217 | 265 | 434 | 535 | 690 | 845 | 995 | 1,145 |
| Monmouth | 105 | 147 | 161 | 225 | 334 | 400 | 573 | 745 | 950 | 1,155 |
| Morris | 83 | 110 | 126 | 164 | 262 | 320 | 425 | 530 | 630 | 730 |
| Passaic | 259 | 302 | 309 | 337 | 407 | 435 | 448 | 460 | 472 | 485 |
| Somerset | 48 | 65 | 74 | 99 | 144 | 170 | 243 | 315 | 433 | 550 |
| Union | 200 | 305 | 328 | 398 | 504 | 560 | 600 | 640 | 650 | 660 |
| Connecticut: | | | | | | | | | | |
| Fairfield | 321 | 387 | 418 | 504 | 654 | 750 | 908 | 1,065 | 1,243 | 1,420 |

Sources: Griffin, John I., and Namis, Jean; Fact Book: New York Metropolitan Region; New York: New York City Council on Economic Education, 1965.

TABLE II

NEW DWELLING UNITS AUTHORIZED
1960 - 1964

| | 1960 | | 1961 | | 1962 | | 1963 | | 1964 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Multi-family (Percent) | Total | Multi family (Percent) | Total | Multi-family (Percent) | Total | Multi family (Percent) | Total | Multi-family (Percent) |
| New York City: | | | | | | | | | | |
| Bronx | 7,470 | 93.0 | 10,890 | 95.9 | 9,690 | 97.0 | 9,020 | 96.4 | 3,681 | 93.3 |
| Kings | 10,050 | 96.2 | 13,290 | 96.0 | 21,330 | 97.1 | 9,860 | 95.3 | 4,997 | 92.4 |
| New York | 13,830 | 100.0 | 19,190 | 100.0 | 21,810 | 100.0 | 10,620 | 100.0 | 2,940 | 100.0 |
| Queens | 13,100 | 91.1 | 25,880 | 94.2 | 14,980 | 91.3 | 17,250 | 93.0 | 6,008 | 85.2 |
| Richmond | 2,250 | 57.4 | 1,360 | 32.7 | 2,810 | 50.0 | 3,150 | 43.7 | 2,968 | 47.8 |
| Other New York: | | | | | | | | | | |
| Dutchess | 680 | 8.8 | 750 | 8.4 | 900 | 24.3 | 1,270 | 23.1 | 1,833 | 37.4 |
| Nassau | 7,530 | 32.0 | 7,780 | 36.2 | 5,940 | 21.4 | 5,710 | 37.0 | 5,090 | 28.7 |
| Orange | 710 | 2.3 | 930 | 4.1 | 1,020 | 11.9 | 1,050 | 11.2 | 1,621 | 25.8 |
| Putnam | 300 | 0.0 | 270 | 1.1 | 510 | 0.0 | 560 | 1.1 | 631 | 7.0 |
| Rockland | 2,020 | 19.4 | 2,030 | 20.2 | 2,780 | 27.4 | 3,690 | 47.8 | 2,886 | 29.4 |
| Suffolk | 10,934 | 5.5 | 11,250 | 6.3 | 14,290 | 17.7 | 11,800 | 7.1 | 13,405 | 7.6 |
| Westchester | 4,030 | 44.5 | 4,490 | 51.0 | 5,430 | 59.2 | 5,280 | 59.9 | 4,574 | 55.0 |
| New Jersey: | | | | | | | | | | |
| Bergen | 4,810 | 32.0 | 4,900 | 41.6 | 4,570 | 42.7 | 6,380 | 56.7 | 6,004 | 48.2 |
| Essex | 3,780 | 63.0 | 5,660 | 84.1 | 3,950 | 77.6 | 3,230 | 74.9 | 4,623 | 84.5 |
| Hudson | 1,410 | 75.6 | 1,740 | 86.0 | 1,180 | 73.0 | 1,870 | 88.3 | 2,958 | 93.7 |
| Middlesex | 3,840 | 23.7 | 3,900 | 27.7 | 3,560 | 31.4 | 3,770 | 40.6 | 9,049 | 67.8 |
| Monmouth | 2,360 | 22.3 | 3,570 | 27.6 | 3,890 | 37.0 | 5,920 | 53.3 | 5,997 | 59.3 |
| Morris | 2,010 | 4.2 | 2,670 | 32.2 | 3,040 | 25.7 | 4,470 | 52.3 | 7,629 | 65.0 |
| Passaic | 2,160 | 40.0 | 2,390 | 48.2 | 3,720 | 64.1 | 2,820 | 53.4 | 3,238 | 65.2 |
| Somerset | 1,390 | 12.8 | 1,850 | 23.6 | 1,690 | 13.0 | 1,770 | 12.4 | 3,063 | 37.2 |
| Union | 3,530 | 47.2 | 3,460 | 53.9 | 3,170 | 55.8 | 2,850 | 60.6 | 3,786 | 63.7 |
| Connecticut | | | | | | | | | | |
| Fairfield | 4,920 | 22.7 | 4,960 | 24.0 | 4,740 | 19.1 | 4,420 | 13.9 | 6,889 | 32.1 |

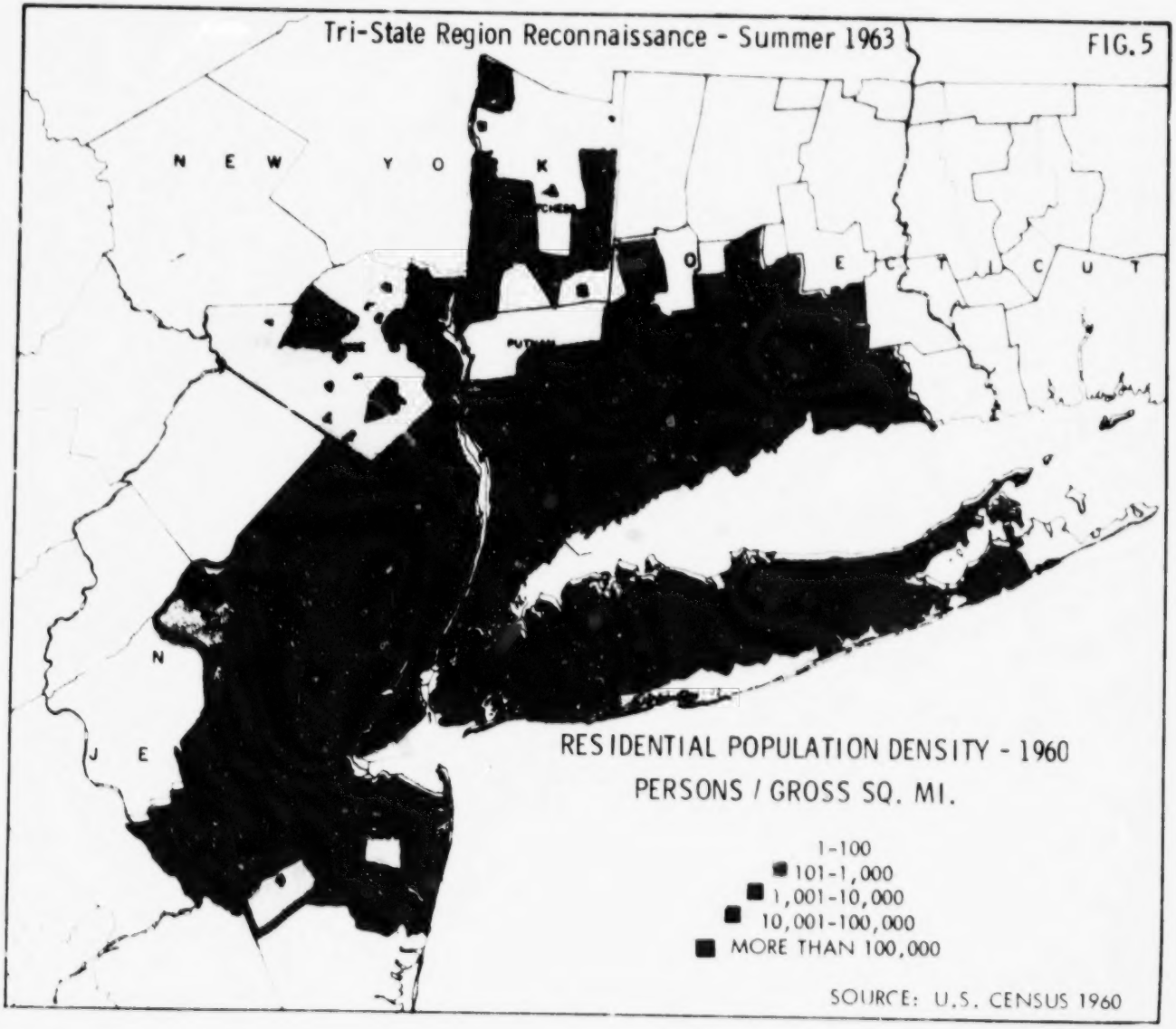
Sources: Griffin, John I., and Namis, Jean; Fact Book: New York Metropolitan Region; New York: New York City Council on Economic Education, 1965.

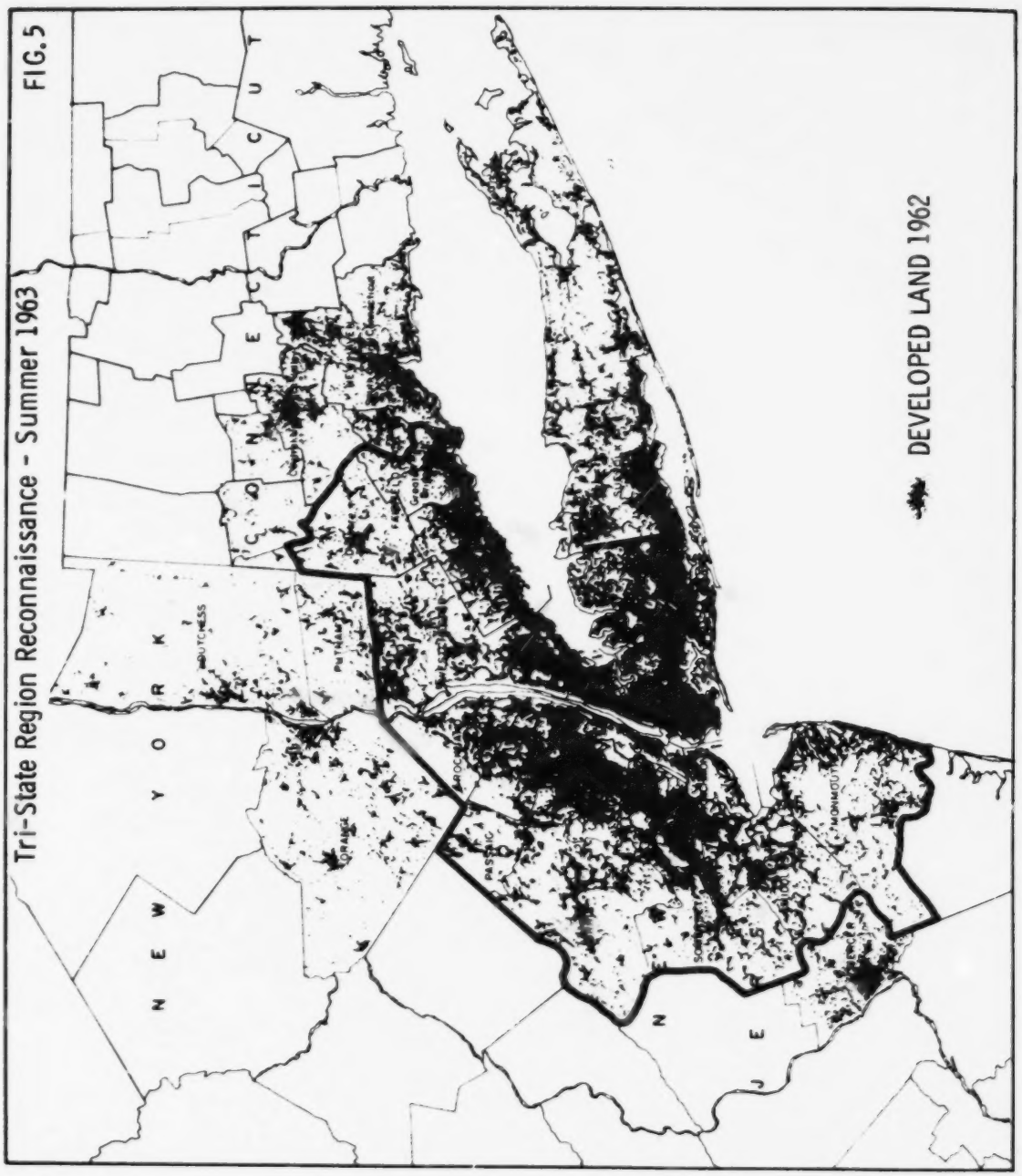
Mitigating against the inclusion of Suffolk County is its size. Suffolk is so large that a majority of its land area is beyond the densely populated and heavily industrialized concentration, and it extends eastward to the Connecticut-Rhode Island boundary. Further, present growth projections indicate that a suburban growth pattern will probably develop for Suffolk County which may be basically devoid of major heavy industrialization.

A second New York county considered for possible inclusion in the Region is Putnam County which borders the core area on the north. Putnam County is perhaps the most sparsely populated county in the Tri-State area. As can easily be seen from figures 4, 5, and 6, it has less developed land and practically no industry as well as having few areas of population concentration. Further, its projected growth suggests no major changes in its present configuration. It is usually considered as a recreation and forest area.

Much the same information applies to Orange and Dutchess Counties. While major population centers do exist, these cities are surrounded by open space. They are also considered to be largely autonomous from the urbanized complex surrounding New York City.

The counties in New Jersey bordering on the nine counties of the Abatement Action area, with the exception of Mercer County, constitute the rural counties of that State. All but Mercer have few built-up areas and even counties with urban centers have rather low overall population densities. Any industrial sources of pollution could probably best be handled on an individual basis and not through a broadly based regional approach.


Tri-State Region Reconnaissance - Summer 1963
FIG. 5
N E W Y O R K
C O N N E C T I C U T
N
J E
RESIDENTIAL POPULATION DENSITY - 1960
PERSONS / GROSS SQ. MI.
1-100
101-1,000
1,001-10,000
10,001-100,000
MORE THAN 100,000
SOURCE: U.S. CENSUS 1960

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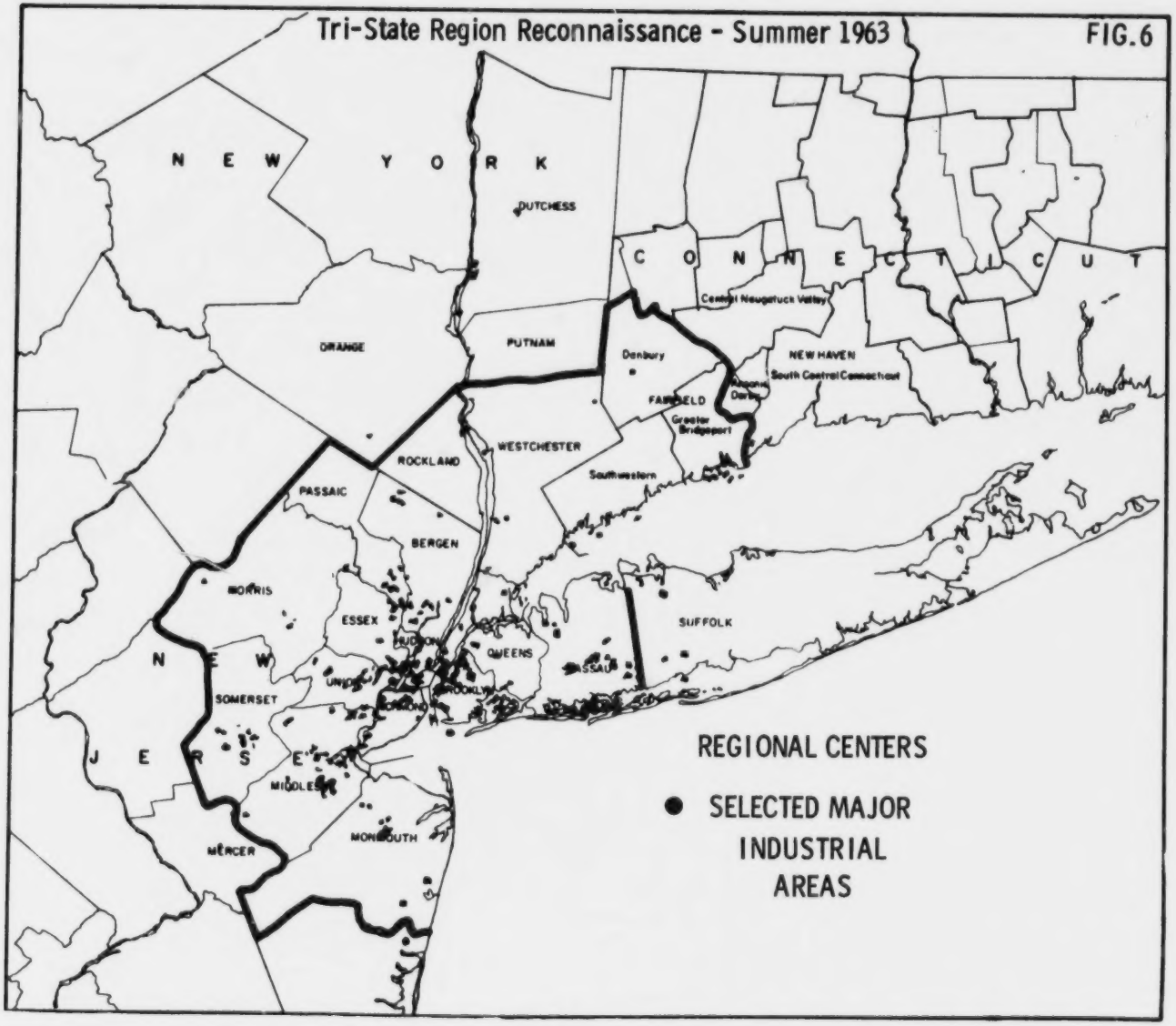
Tri-State Region Reconnaissance - Summer 1963
FIG.6
N E W Y O R K
DUTCHESS
C O N N E C T I C U T
Central Naugatuck Valley
ORANGE
PUTNAM
Danbury
NEW HAVEN
South Central Connecticut
Norwalk
Darien
FAIRFIELD
Greater Bridgeport
WESTCHESTER
ROCKLAND
Southwestern
PASSAIC
BERGEN
MORRIS
ESSEX
HUDSON
QUEENS
SUFFOLK
NASSAU
UNION
BROOKLYN
N E W
SOMERSET
J E R S E Y
MIDDLESEX
MONMOUTH
MERCER
REGIONAL CENTERS
● SELECTED MAJOR INDUSTRIAL AREAS

Mercer County is heavily built up and contains significant industrial concentrations. However, many commercial indicators[2] suggest that it is closely tied to the Penjerdel area surrounding Philadelphia and might best be considered for inclusion in a region developed for that area.

Appendix C contains additional data on urban factors in the New Jersey-New York-Connecticut interstate area. In that appendix, data is arranged in tabular form to provide a well-organized summary of quanitiative information relevant to designation of the Region.

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[2] Ibid.

## SUMMARY

All available information on current measures of urbanization suggest that there are eight counties in New York, nine counties in New Jersey, and all but a small portion of one county in Connecticut that share common characteristics; the counties are: in New York--Kings, Bronx, Nassau, New York, Queens, Richmond, Weschester, and Rockland; in New Jersey--Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union; and in Connecticut--Fairfield. The characteristics that they share--heavy urbanization, related patterns of expected growth, interdependence of dwelling and employment locations, and cooperative regional planning--make these 18 counties (located in three States) a logical choice to serve as at least the core of an air quality control region. At the same time, there is (with three exceptions) enough undeveloped land in and beyond the outermost of these 18 counties to provide a "buffer" for future growth. The exceptions are: (1) Mercer County in New Jersey; (2) Suffolk County in New York; and (3) New Haven County in Connecticut.

Both Mercer and New Haven counties are well populated and industrialized, but neither of them are closely related to the New York urban area socially, commercially, or governmentally. Mercer County is more closely tied to the combination of jurisdictions which looks to Philadelphia as its economic, cultural, and social center. New Haven is an autonomous urban area in South-central Connecticut. These two counties could be ruled out of the New York-New Jersey-Connecticut Region on this basis.

Of the three exceptions mentioned, Suffolk County in Long Island presents the only real difficulty. Population densities range from 10,000 per square mile in the western part of the county to less than 100 people per square mile in the eastern portion. The county is approximately 85 miles long and essentially parallels the entire sea coast of the State of Connecticut. While Suffolk County has relatively few large sources of air pollution when compared to the other counties, it is presently the sixth most populated New York county in the area, and is projected to rank third by 1985. The final determination on Suffolk County should weigh the need to provide a large suburban population protection from and a voice in the control of regional air pollution against administrative difficulties that might be generated by the inclusion in the Region of such a large and diverse county.

## ENGINEERING EVALUATION

The engineering evaluation was based on studies of pollutant emissions, meteorology, available ambient air quality data, and air quality levels as determined on the basis of diffusion model calculations. With the exception of the diffusion model results, the two major sources of data were the technical report for the New York-New Jersey Air Pollution Abatement Activity[1], and Air Pollution Measurements of the National Air Sampling Network.[2]

The Abatement Action emission inventory included estimates for three major pollutants--sulfur oxides, carbon monoxide, and suspended particulates for the New York and New Jersey portions of the three-State urban area.[1] The results of that work are summarized on an annual basis for major jurisdictions and source categories in Tables A-2 through A-4 in Appendix A. Table A-5 presents similar results for the three major SMSA's in southwestern Connecticut. The estimated annual emissions of each of the three pollutants were then converted to average or mean daily emissions for three different time periods--annual, winter, and summer--by apportioning according to heating-degree days those emissions that vary as a function of heating season;[3] the results (Table A-6 in Appendix A and Table III) served as the basis of the diffusion model calculations.

The pattern of sulfur oxides, carbon monoxide, and particulate emissions and the resultant concentration patterns provide a good measure of the general geographical extent of the overall problem. The estimate of sulfur oxide pollution levels illustrates the impact

TABLE III. MEAN DAY EMISSIONS FOR VARIOUS AVERAGING TIMES
(TONS)

| County or City | Sulfur Dioxide | | | Carbon Monoxide | | | Particulates | | |
|---|---|---|---|---|---|---|---|---|---|
| | Annual | Winter | Summer | Annual | Winter | Summer | Annual | Winter | Summer |
| Bergen Co. | 246 | 332 | 178 | 1,366 | 1,295 | 1,430 | 30 | 42 | 21 |
| Essex Co. | 283 | 464 | 140 | 1,301 | 1,230 | 1,360 | 31 | 47 | 18 |
| Hudson Co. | 404 | 551 | 288 | 645 | 615 | 680 | 43 | 52 | 35 |
| Middlesex Co. | 517 | 619 | 437 | 1,074 | 1,020 | 1,120 | 26 | 28 | 24 |
| Monmouth Co. | 45 | 72 | 23 | 544 | 515 | 570 | 12 | 17 | 8 |
| Morris Co. | 58 | 101 | 23 | 459 | 435 | 480 | 13 | 18 | 9 |
| Passaid Co. | 85 | 147 | 36 | 550 | 520 | 575 | 16 | 21 | 12 |
| Somerset Co. | 60 | 88 | 38 | 190 | 180 | 200 | 11 | 14 | 9 |
| Union County | 365 | 480 | 274 | 826 | 785 | 860 | 21 | 26 | 18 |
| New Jersey Subtotal | 2,063 | 2,854 | 1,437 | 6,955 | 6,595 | 7,275 | 202 | 264 | 153 |
| Bronx Bor. | 252 | 433 | 109 | 610 | 580 | 635 | 35 | 49 | 25 |
| Kings Co. (Brooklyn) | 535 | 895 | 251 | 980 | 930 | 1,020 | 62 | 83 | 45 |
| Nassau Co. | 156 | 213 | 112 | 1,699 | 1,610 | 1,775 | 34 | 42 | 29 |
| New York Co. (Manh.) | 621 | 888 | 410 | 1,057 | 1,000 | 1,105 | 57 | 65 | 51 |
| Queens Bor. | 529 | 762 | 345 | 1,735 | 1,645 | 1,810 | 41 | 66 | 21 |
| Richmond Co. | 64 | 88 | 45 | 134 | 125 | 140 | 9 | 12 | 6 |
| Rockland Co. | 29 | 34 | 25 | 274 | 260 | 285 | 12 | 14 | 10 |
| Westchester Co. | 85 | 145 | 38 | 1,245 | 1,180 | 1,300 | 27 | 35 | 20 |
| Suffolk Co. | - | - | - | - | - | - | - | - | - |
| New York Subtotal | 2,271 | 3,458 | 1,335 | 7,734 | 7,330 | 8,070 | 277 | 366 | 207 |
| Stamford SMSA | 46 | 69 | 27 | 284 | 270 | 295 | 11 | 13 | 8 |
| Norwalk SMSA | 157 | 234 | 94 | 168 | 160 | 175 | 7 | 9 | 6 |
| Bridgeport SMSA | 355 | 531 | 213 | 436 | 415 | 455 | 18 | 21 | 16 |
| AREA TOTALS | 4,892 | 7,146 | 3,106 | 15,577 | 14,770 | 17,070 | 515 | 673 | 390 |

of fuel burning activities at private and commercial sources, or government-owned power plants. Carbon monoxide pollutant levels provide the best indication of the impact of gasoline-powered motor vehicles on the regional air pollution pattern since over 95 per cent[4] of all carbon monoxide emitted in the New York City metropolitan area comes from motor vehicles. Diffusion model estimates of suspended particulate levels provide the best measure of the combined impact of all source categories, since, of the three pollutants covered in the emission inventory, particulate emissions are the most evenly distributed by source category (no single source category accounts for more than 29 per cent of the total--see Tables A-2, A-3, and A-4). There are undoubtedly, other pollutants that on occasion will have different dispersion patterns, but the three used here are considered to adequately reflect the "average" geographical extent of the problem.

By estimating the patterns of dispersion of these three major pollutants, the diffusion model technique provides a guide as to a possible minimum boundary for the region but does not dictate the exact boundary location. By way of example, significant levels of one or more of the three pollutants extending into a county contiguous to the major urbanized area would indicate that that county is being subjected to a pollutant load that constitutes a part of the total-area problem. This county, then, should be considered for inclusion in the air quality control region, but the final decision will be based on joint consideration of this as well as the non-engineering evaluation.

Average emission densities for each of the three pollutants in tons/sq. mi./ day were determined by relating the total quantity of

pollutants emitted in each of the reporting zones for average space-heating-day conditions to land area of each zone. The resulting emission densities are presented graphically in Figures 7, 8, and 9. The general pattern of emission densities for each of the three pollutants is closely related to the pattern of urbanization in the central portion of the New York-New Jersey area. The highest emission densities occur in or close to the Manhattan area, but the density pattern in each case extends well into Queens, Brooklyn, and the Bronx in New York, and into Hudson, Essex, Union, Bergen and Middlesex counties in New Jersey.

## DIFFUSION MODEL RESULTS

While the geographical distribution of pollutant sources illustrates clearly the core of the air quality control region, it does not, by itself, provide complete insight as to the extent of influence of the combined sources on the people and property located outside the highly urbanized portion of the greater New York City metropolitan area. A study of air quality levels known or estimated to occur is useful in determining the area affected by the pollution sources and thus subject to inclusion in the air quality region. Such analysis can be based directly on air quality sampling data in those instances where the sampling program covers a large-enough area and has been in existence long enough to provide reliable patterns of air quality throughout the region under study. Such air quality data rarely exists, and it becomes necessary to develop estimates of prevailing air quality. The diffusion model is the technique by which such

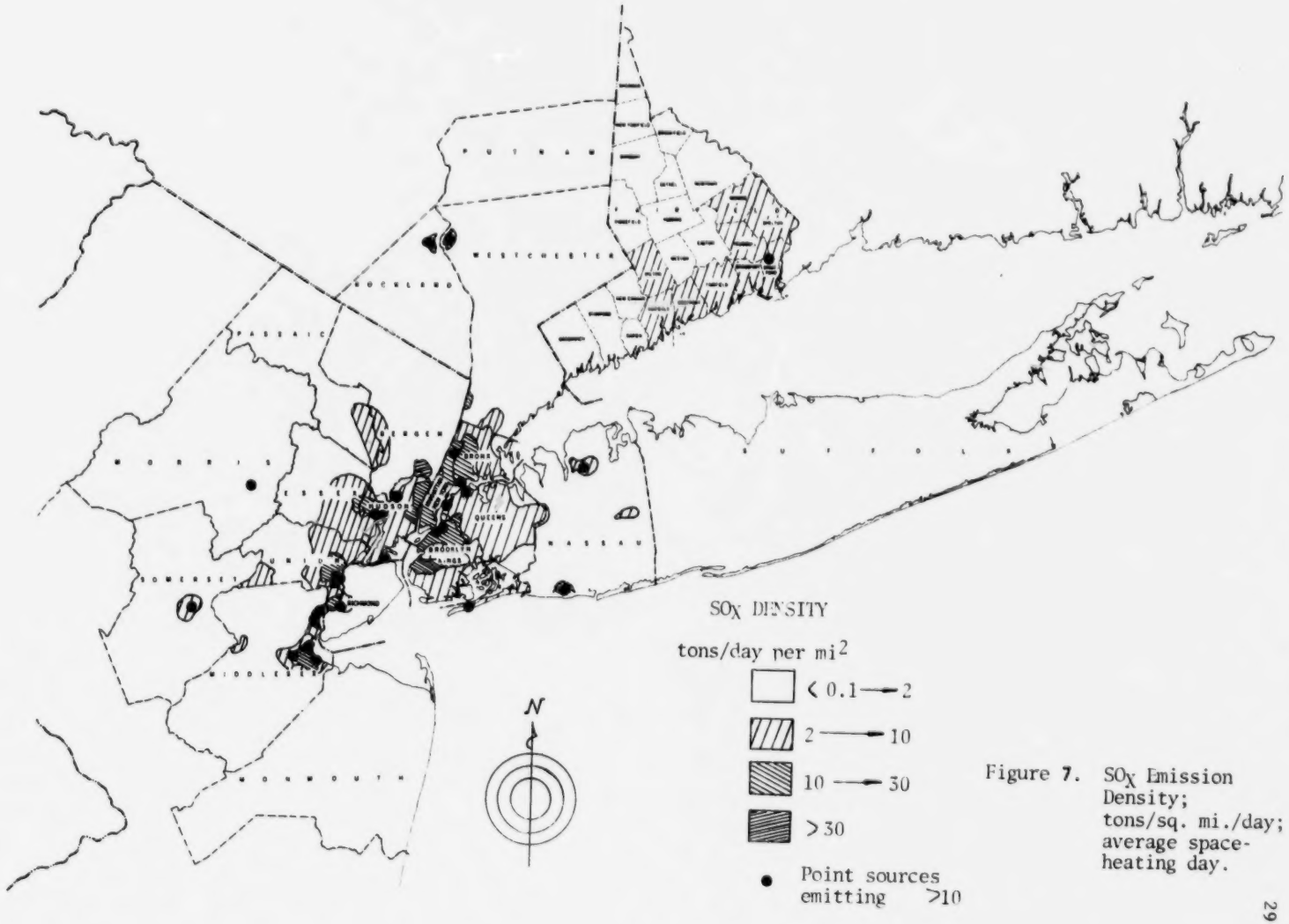



Figure 7. $SO_X$ Emission Density; tons/sq. mi./day; average space-heating day.

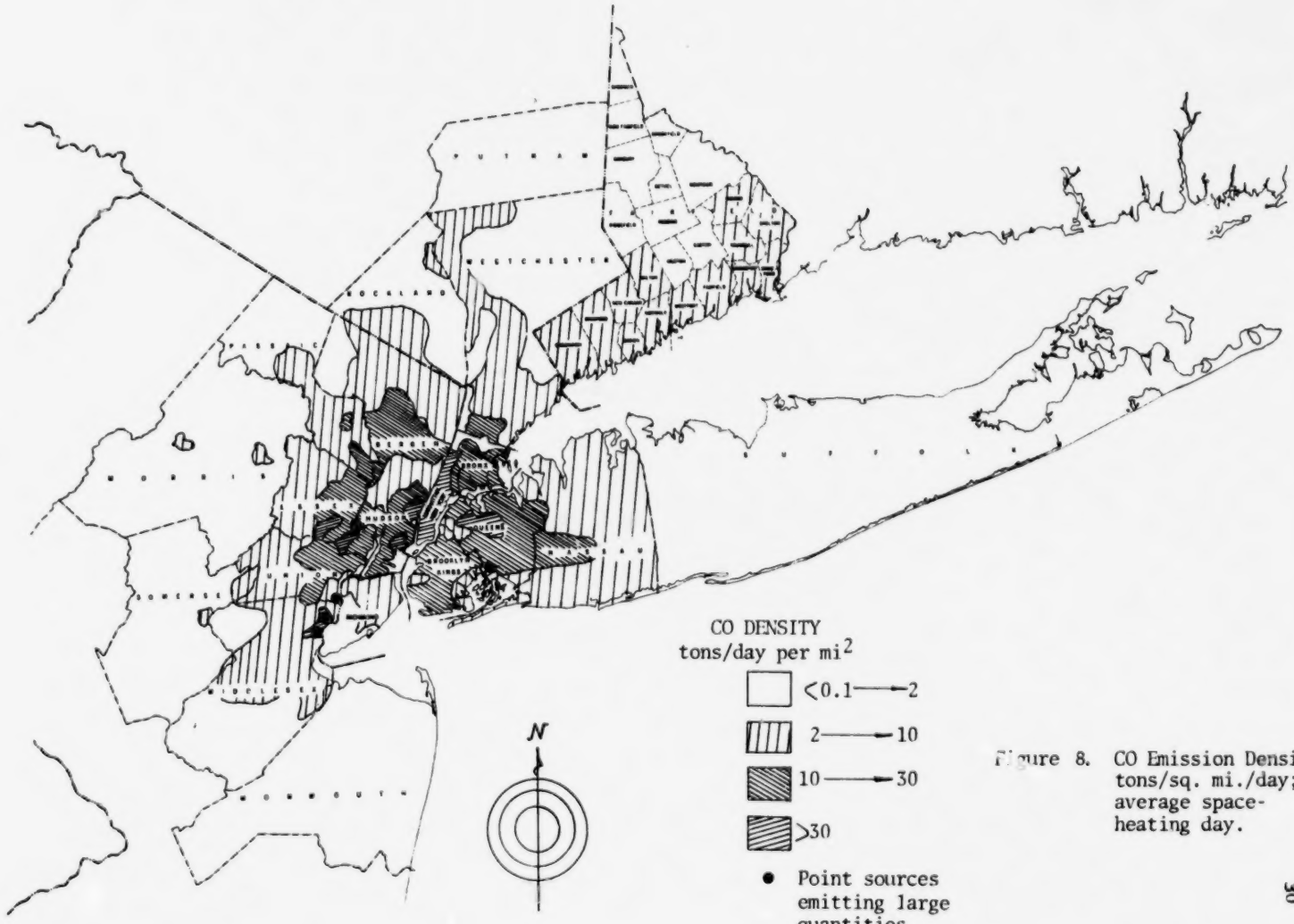



Figure 8. CO Emission Density; tons/sq. mi./day; average space-heating day.

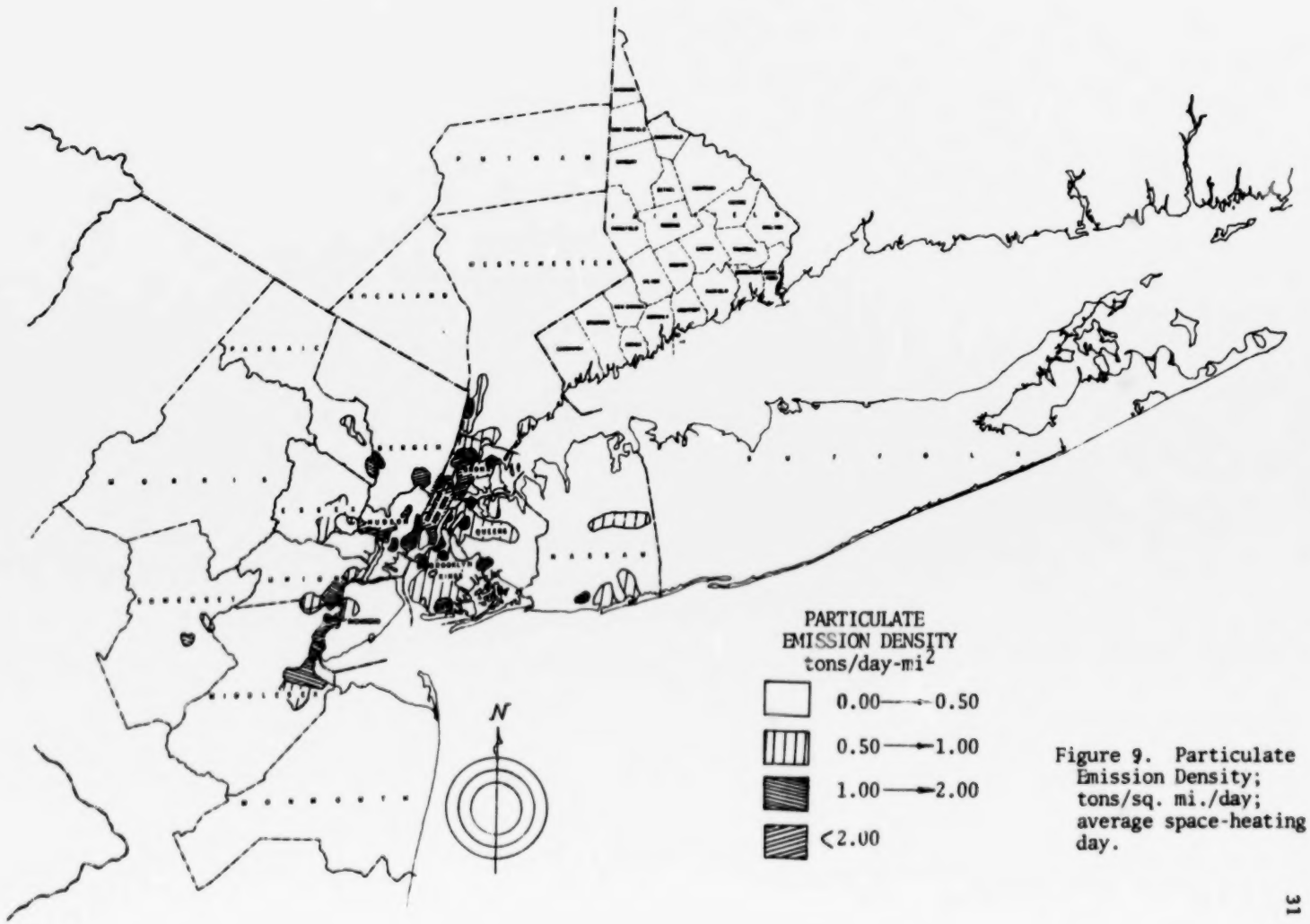
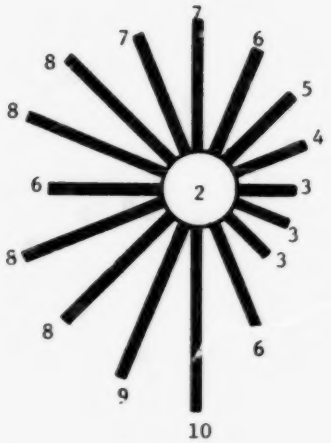



Figure 9. Particulate Emission Density; tons/sq. mi./day; average space-heating day.

estimates are made on the basis of information on pollutant emissions, meteorological conditions, and the physical character of the urban complex. The diffusion model used in this study and the results obtained are covered in detail in Appendix B and summarized briefly below.

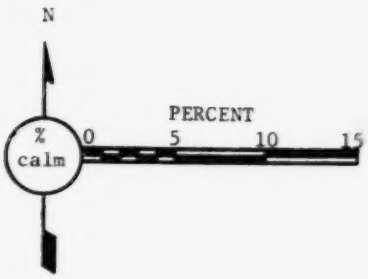
The model is based on the long-term Gaussian diffusion equation, described by Pasquill[5] and modified in recent years[6, 7] for application to the multiple-source situation of an urban area. The basic equation assumes that the concentration of a pollutant within a plume has a Gaussian distribution about the plume centerline in the vertical and horizontal directions, with the standard deviations in the two directions being a function of distance from the source and certain characteristics of mixing layer, collectively referred to as "stability class." Graphs have been developed which give $\sigma_z$ (vertical) and $\sigma_y$ (horizonal) diffusion coeffiecients versus stability class and distance downwind. Reference 5 describes the Gaussian-based diffusion model and the inherent assumptions made when it is applied.

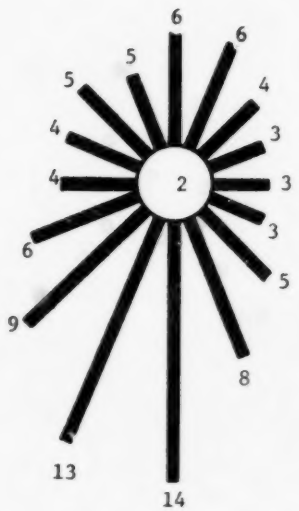
The diffusion model was applied for each of the three pollutants for the three different time periods--annual, winter, and summer. Figure 10and Table IV show the meteorological data required to apply the model for each of the three time periods. Figure 10 shows the percent frequency of occurrence of wind direction from 1951 through 1960 at John F. Kennedy Airport for summer, winter, and annual conditions. The wind rose data (speed and direction) for JFK Airport were used in the diffusion model calculation on the assumption that it adequately



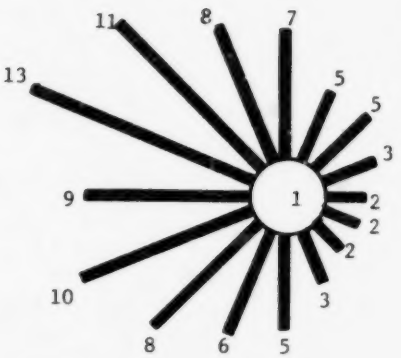

ANNUAL

Figure 10. Percent frequency of wind direction for various averaging times, based on 1951-60 data from Kennedy International Airport.




SUMMER
(June, July, August)




WINTER
(December, January, February)

represents (for long-period averaging) prevailing wind patterns throughout the area. The mixing depths for the time periods are an average of the mean daytime and mean nighttime values as shown in Table IV; these data were obtained from the National Weather Records Center (ESSA). Combined with wind data, these data are used in the diffusion model to assess the spatial distribution of pollutant concentrations on the 16 points of the compass.

Table IV. Average mixing depths for New York City by season.

| Season | Mixing Depths, Meters | | |
|---|---|---|---|
| | Daytime Average | Nighttime Average | Average Daytime and Nighttime |
| Winter (Dec., Jan., Feb.) | 907 | 870 | 889 |
| Summer (June, July, Aug.) | 1513 | 650 | 1081 |
| Annual | 1216 | 745 | 981 |

Using the foregoing information on emissions and meteorology, concentrations were calculated for each of the three pollutants for each of the three time periods at a total of 97 ground-level receptor points (20, 30, 40, 50, 70, and 100 kilometers from an assumed center point located in Central Park, Manhattan, at each of 16 compass points, plus a calculation of the concentration of the center point itself). The theoretical concentrations estimated by this process are in addition to "background" levels since the model was not supplied with information

on sources located outside the area initially surveyed. The results are presented in Figures B-1 through B-13 in Appendix B as theoretical concentrations and are discussed in greater detail below.

SULFUR OXIDES

Figures B-1 through B-3 in Appendix B show the results of the theoretical model calculations for $SO_x$. Actual sampling data suggest that the model over-estimates concentrations of this pollutant by a factor of 3-4 (Figure B-2), in part because no allowance was made for $SO_x$ decay (the reaction of $SO_x$ in the atmosphere into other sulfur compounds). Figure 11 was produced by applying a "decay factor" involving a 3-hour half-life to the initial output of the model. Figures B-5 and B-6 in Appendix B show resulting contour lines after decay factors involving 6-hour and 12-hour half-lives, respectively, were arbitrarily selected for analysis. The result incorporating the 3-hour half-life was chosen for discussion here because the results, though still theoretical, gave the best correlation with sampling data. Comparison of the diffusion model contours and the available monitoring data in Figure 11 show the estimates fall well within a factor of two of the measured concentrations.

Concentration contours are presented in Figure 11 down to a concentration of 0.01 ppm. This has been pointed out as the average annual concentration at which human health begins to show signs of deterioration; it is also assumed that this level is close to the background level in highly urbanized areas.

CARBON MONOXIDE

The results of the theoretical model estimates of carbon monoxide

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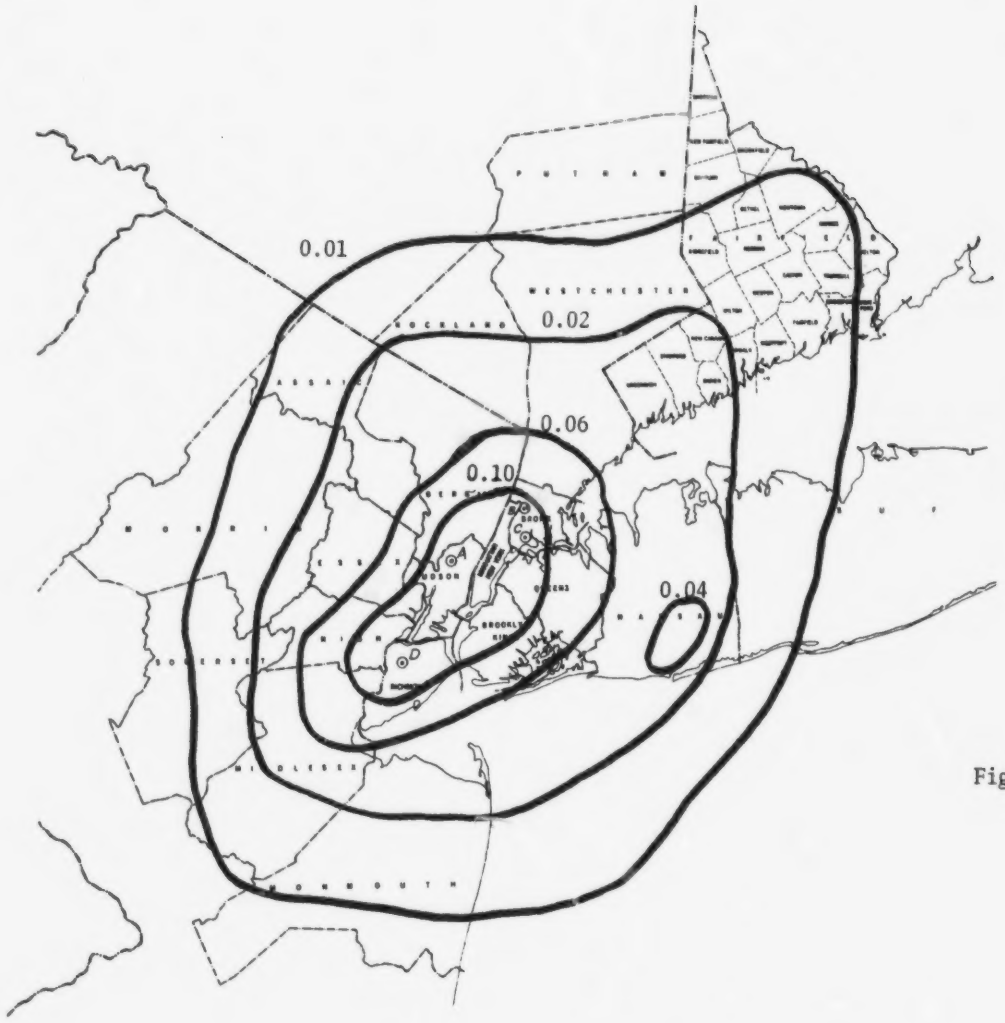



| Aerometric Data[1] | |
|---|---|
| Station | Concentration |
| A | 0.14 |
| B | 0.15 |
| C | 0.15 |
| D | 0.09 |

$SO_x$--ppm

Figure 11. Theoretical $SO_x$ concentration, annual average, includes an assumed 3-hour half-life.

concentrations for the three seasonal conditions are presented in Figures B-8 through B-10 in Appendix B. The results for an average summer day are discussed here since, of the three seasons considered, this gave the highest theoretical results. Aerometric data from seven stations plotted on Figure B-9 indicate that the model routinely estimated concentrations 2-11 times lower than those reported at actual sampling sites. For the purpose of showing the relative distribution of CO levels, the model estimates are adequate; but choosing a cut-off level that has relevance in terms of those values routinely reported from sampling is difficult because of the 2-11 factor mentioned above. The diffusion model does not reflect the built-up nature of the area in which most of the CO is emitted and thus assumed that the pollutant has more immediate space and volume within which to disperse. Until the air into which the pollutant is being emitted moves away from the built-up part of the urban area, the pollutant is channeled through streets and around buildings. This fact is assumed to cause some of the discrepancy between estimated and measured concentrations of CO. Also, it is recognized that most CO measurements were made at judiciously selected locations (e.g., near highways, shopping centers, etc.) which would be expected to yield higher concentrations than theoretical average values.

Based on the 2-11 difference, an average factor of 4.5 was derived and applied to the theoretical diffusion model estimates to give "adjusted" CO concentrations. In so doing, the relative distribution of CO levels calculated by the model is preserved, while

the finite values assigned to the contours are brought more into line with actual sampling results. The resulting CO level estimate is shown in Figure 12. Theoretical contours have been plotted for 4, 3, 2, and 1 ppm of the pollutant. 1 ppm of CO is assumed to be close to the background level in most highly urbanized areas; this value at the outskirts of an area, then, might be used as a starting point in defining the area affected by sources within the Region.

SUSPENDED PARTICULATES

The diffusion model estimates of theoretical suspended particulate concentrations are less than ideal for two reasons: 1) they do not include an allowance for background concentrations; and, 2) they are based on an emission inventory that estimates total particulate emissions, and therefore, no deposition term is applied. The first would cause the model estimate to be lower than measured concentrations, and the second would cause the estimate to be higher than measured concentrations of suspended particulates.

Theoretical results are compared with aerometric data for 13 stations in New York and New Jersey in Table V. The theoretical values were, on the average, 0.60 of the measured results. When this factor was applied to the diffusion model contour lines, the "adjusted theoretical" contour lines of Figure 13 resulted.

Two methods were utilized to analyze the particulate contours shown in Figure 13. Assuming 40* $\mu g/m^3$ as a background level for the non-urban

*Based on average suspended particulate concentrations for non-urban stations in this area from National Air Sampling Network.

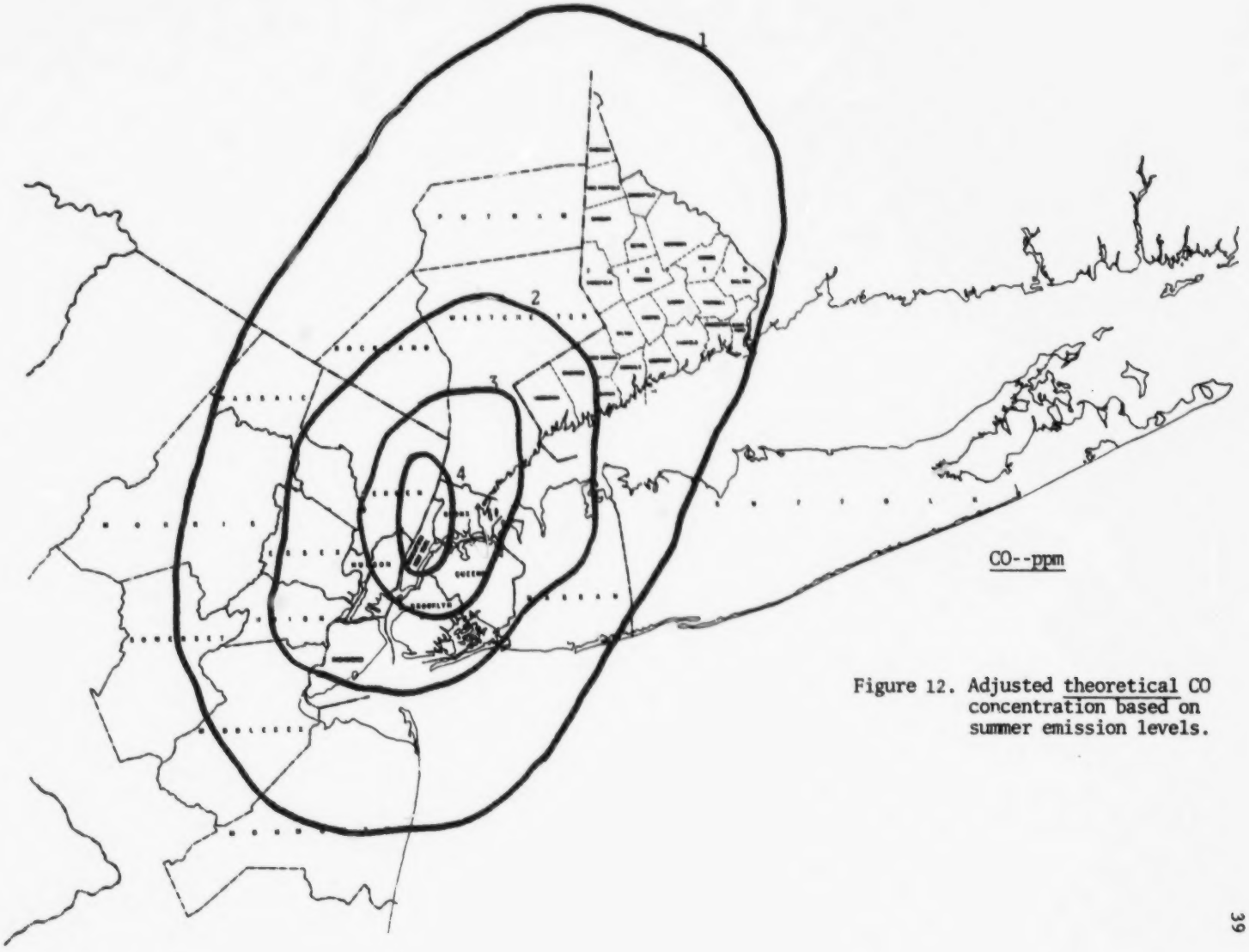
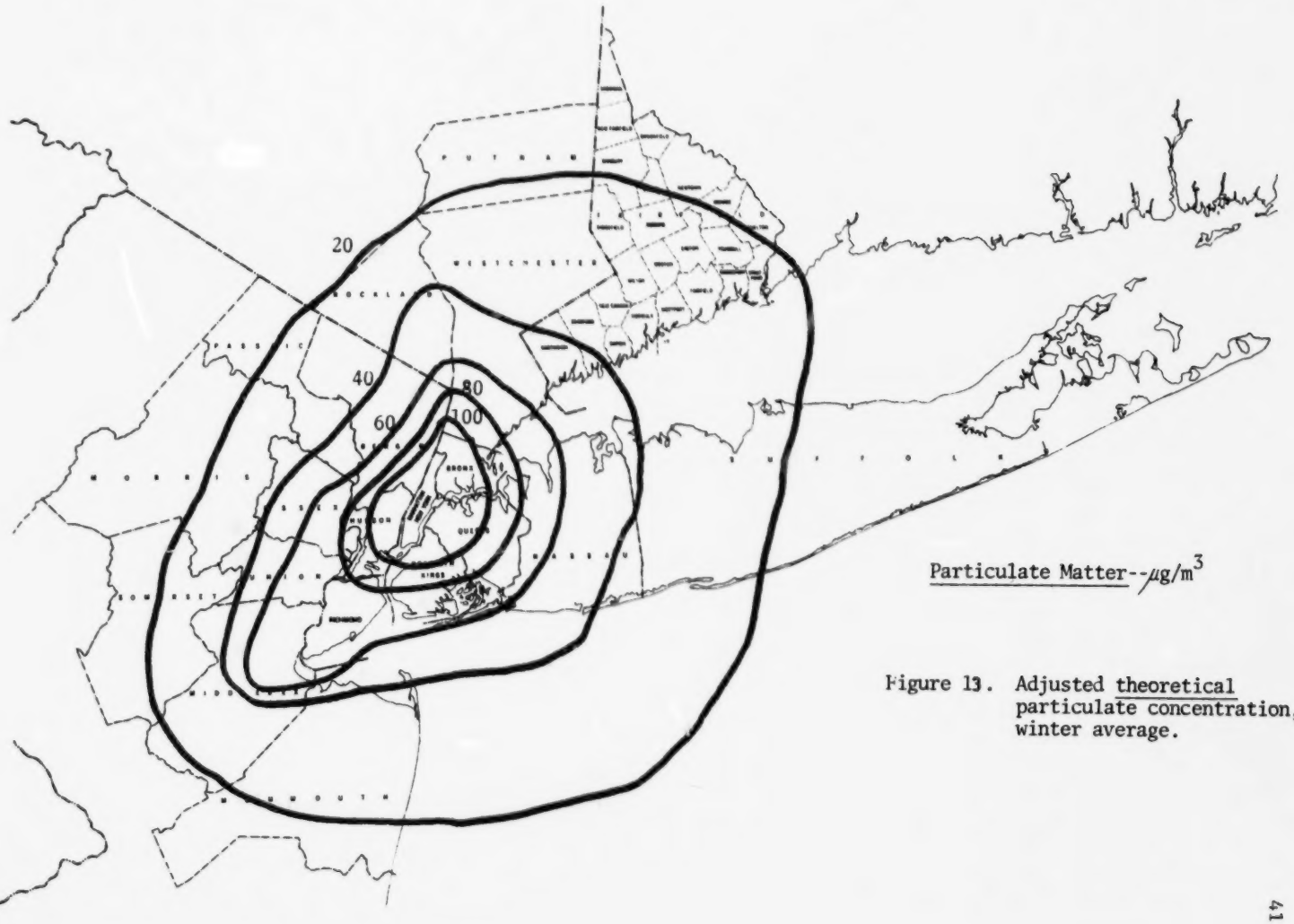



Figure 12. Adjusted theoretical CO concentration based on summer emission levels.

TABLE V- RELATIONSHIP OF DIFFUSION MODEL RESULTS FOR SUSPENDED PARTICULATES TO AEROMETRIC DATA.

| Location | Concentration, $m^3$ | | Ratio Estimated To Measured |
|---|---|---|---|
| | Estimated | Measured | |
| Willowbrook | 60 | 85 | 0.71 |
| Roselle | 45 | 102 | 0.44 |
| Fairview | 70 | 112 | 0.63 |
| Ft. Hamilton | 48 | 82 | 0.59 |
| Bayonne | 50 | 96 | 0.52 |
| Newark | 55 | 189 | 0.28 |
| NYU | 70 | 111 | 0.64 |
| 121st Street | 100 | 150 | 0.67 |
| New Rochelle | 50 | 104 | 0.48 |
| Ancora | 17 | 42 | 0.40 |
| Lower Manh. | 85 | 100 | 0.85 |
| Mid-Manh. | 123 | 141 | 0.87 |
| Jersey City | 80 | 112 | 0.72 |
| Total, New York, New Jersey | | | 7.80 |
| Average ratio: 7.80/13 = 0.60 | | | |




Particulate Matter--$\mu g/m^3$

Figure 13. Adjusted theoretical particulate concentration, winter average.

areas surrounding the New York City urban complex, the area enclosed by this contour line might be considered the area most affected by particulate emissions in the New York City metropolitan area. Relative values of particulate concentration are shown in Figures 14 and 15. The "relative concentrations" are plotted versus location along the two major axes (north-south, east-west) and along the northeast-southwest axis. Shown also are the boundary locations along the axes for the jurisdictional entities. The relative impact of pollution emissions within the New York City metropolitan area becomes less significant with increasing distance outward from the Central Park reference point. The slope towards the bottom portion of each curve approaches zero, thus pointing out approximately where the impact of the sources within the region begins to lose significance in the outlying areas.

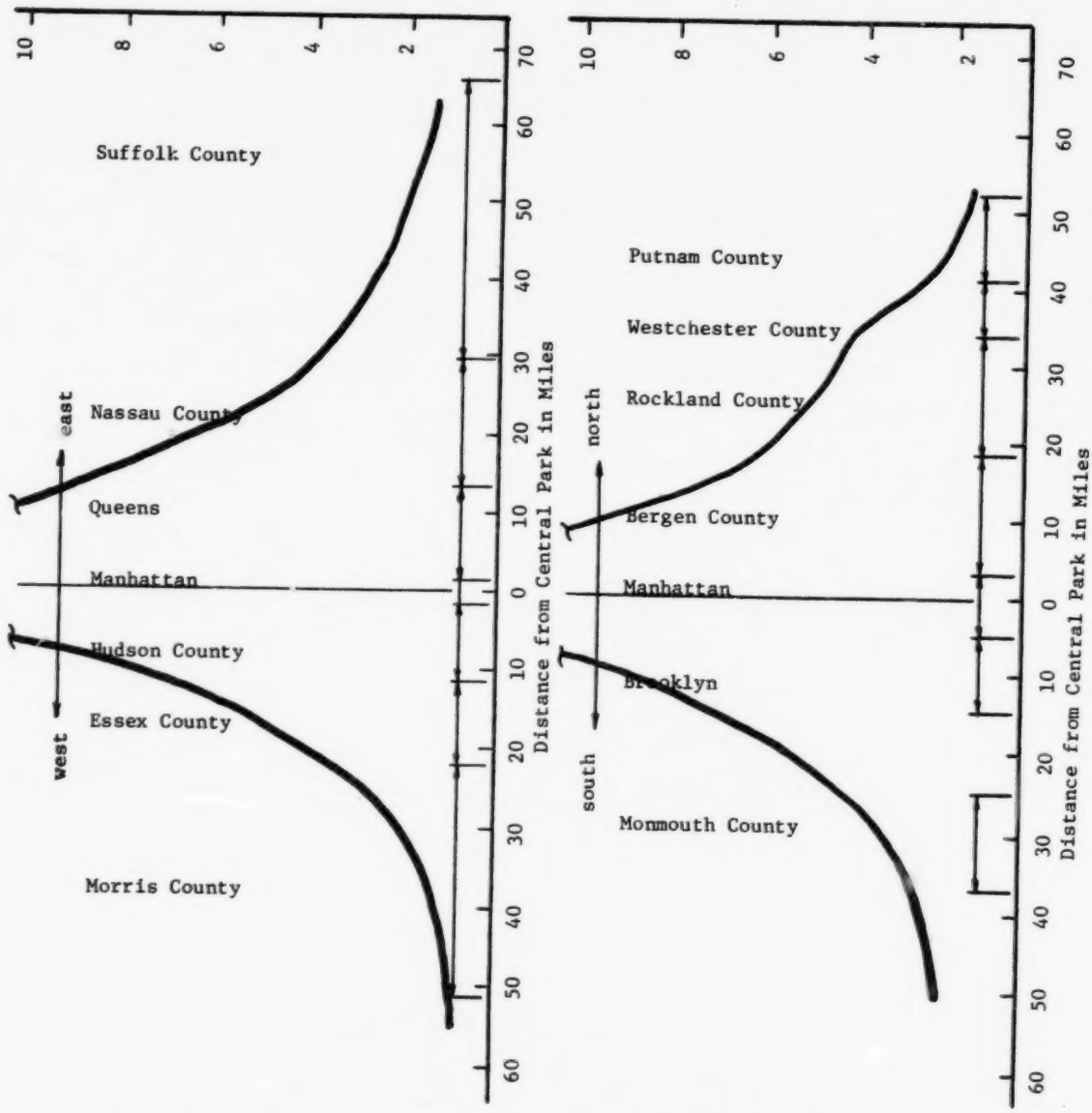



Figure 14. Relative concentration of suspended particulates on major axes centered on Central Park.

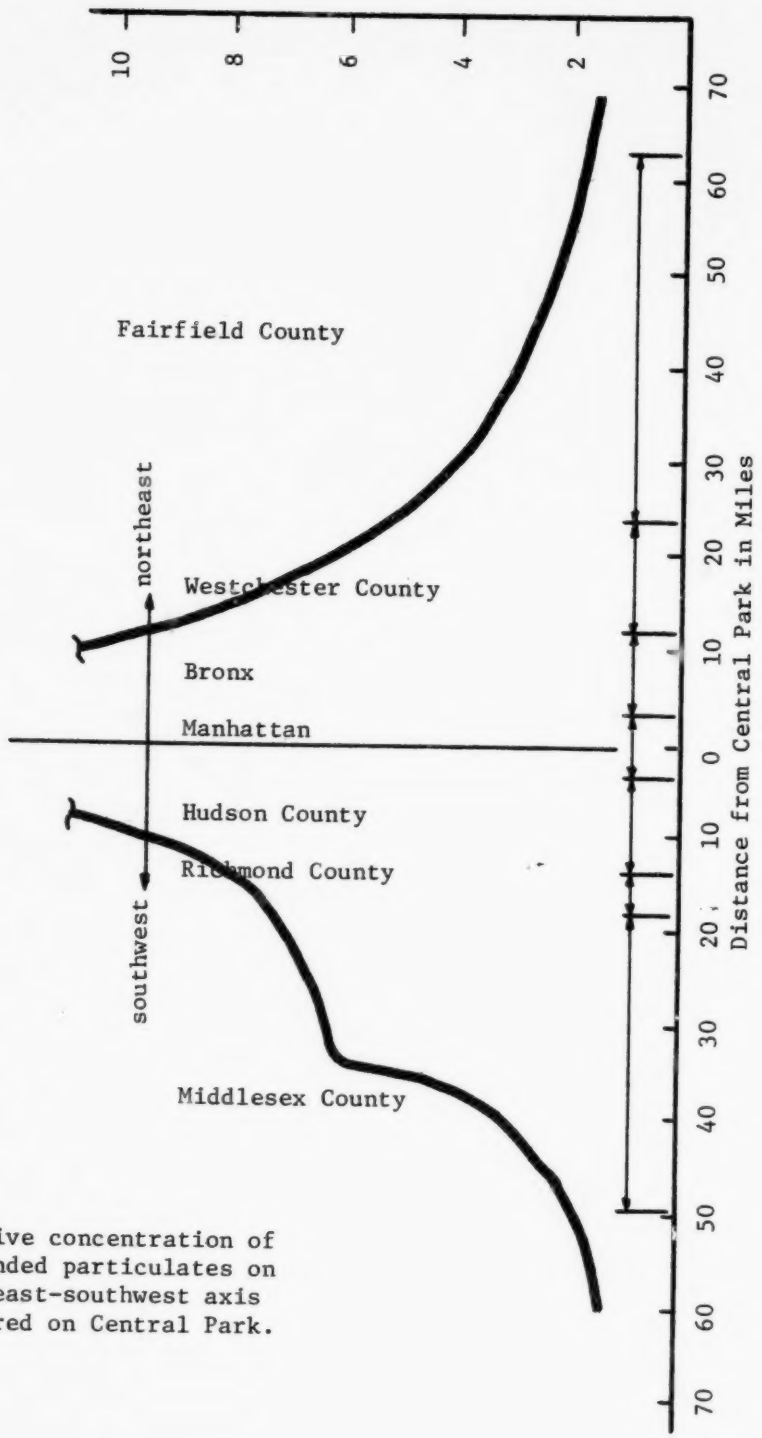



Figure 15. Relative concentration of suspended particulates on northeast-southwest axis centered on Central Park.

SUMMARY

The 0.01 ppm $SO_x$ contour line includes all or most of the land area in the following counties: nine counties in New Jersey--Passaic, Morris, Somerset, Middlesex, Monmouth, Essex, Bergen, Hudson, and Union; eight counties in New York--Manhattan, Bronx, Queens, Kings, Richmond, Nassau, Westchester, and Rockland; and Fairfield County in Connecticut. The line also includes small portions of Mercer County, New Jersey, and Suffolk and Orange Counties, New York.

Enclosed by the 1 ppm CO contour line are the same nine counties in New Jersey, the same eight counties plus Putnam County in New York, and Fairfield County, Connecticut. The 1 ppm contour line also includes small portions of Orange, Dutchess, and Suffolk Counties in New York, and of New Haven and Litchfield Counties in Connecticut.

The 40 $\mu g/m^3$ contour line for particulates encompasses most or all of Hudson, Union, Essex, and Bergen Counties in New Jersey, and Manhattan, Bronx, Richmond, Queens, Kings, and Nassau Counties in New York. Partly included counties are Monmouth and Middlesex Counties in New Jersey, Rockland, Westchester and Suffolk Counties in New York, and Fairfield County in Connecticut.

The relative concentration curves indicate that particulate pollution emanating from within the area covered by the emission inventory tends to become significant at the outer edge of Morris County to the west and Suffolk County to the east, at the outer edge of Monmouth to the south and Putnam County to the north. Similarly, the NE-SW concentration profile shows tnat the relative impact is insignificant

at the outer edge of Middlesex County to the southwest and Fairfield County to the northeast.

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## APPENDIX A. EMISSION INVENTORY PROCEDURE

The recent emission inventory as part of the New York-New Jersey Air Pollution Abatement Activity[1] provided the information on emissions necessary to study the area prior to the designation of an air quality control region. Data for New York and New Jersey were compiled during a 3-month period from June through August, 1966, for $SO_X$ and CO, and from February to October, 1967, for particulates. Data for Connecticut are also for 1966 and were obtained through personal communication with the State of Connecticut. The Public Health Service[2] and the New York State emission inventory procedures were employed with some modifications. The emission inventory consisted of evaluating the consumption of gasoline, diesel fuel, coal, fuel oil, and natural gas and of determining emissions from refuse incineration and process industries. Emissions were determined directly from the fuel input to the equipment for both automotive and stationary sources. Emission factors[3] and sulfur contents are listed in Table A-1. These factors were used wherever more specific information was not available.

Annual consumption of all fuels, process emissions, and incineration emissions were determined for each zone in the New York-New Jersey portion of the study area.

Tables A-2 through A-4 summarize the estimates of annual emissions of sulfur oxides, carbon monoxide, and particulates by source category and political jurisdiction for New York and New Jersey. Less complete data are shown in Table A-5 for Connecticut by SMSA.

TABLE A-1--EMISSION FACTOkS AND SULFUR CONTENTS OF PRINCIPLE FUELS USED IN STUDY AREA AND EMISSION FACTORS FOR INCINERATION

| | Sulfur Content % | $SO_x$ as $SO_2$ | CO | Particulate | |
|---|---|---|---|---|---|
| | | | | Ind. | Other |
| Anthracite Coal | 0.625 | 25 lb/ton | 50 lb/ton | 50 lb/t | 35 lb/ton |
| Bituminous Coal | 1.875 | 75 lb/ton | 1 lb/ton | 50 lb/t | 35 lb/ton |
| Distillate Oil | 0.575 | 85 lb/1000 gal. | 22 lb/1000 gal. | 11.1 lb/1000 gal. | |
| Residual Oil | 2.45 | 390 lb/1000 gal. | 0 | 12 lb/1000 gal. | |
| Natural Gas | Neg. | 0.6 lb/$10^6$ft$^3$ | 0.4 lb/$10^6$ft$^3$ | 19 lb/$10^6$ft$^3$ | |
| Diesel Fuel | 0.30 | 45 lb/1000 gal. | 60 lb/1000 gal. | 110 lb/1000 gal. | |
| Gasoline | 0.03 | 5 lb/1000 gal. | 2910 lb/1000 gal. | 11 lb/1000 gal. | |
| Municiple Incinerator (multiple-chamber) | | 1.9 lb/ton | 0.7 lb/ton | 4.5 lb/ton | |
| Flue-fed Incinerator | | | | 25 lb/ton | |
| Other Small or single-chamber Incinerator | | 0.3 lb/ton | 25 lb/ton | 25 lb/ton | |
| Backyard (open-burning) Incinerator | | 0.3 lb/ton | 0 lb/ton | 20 lb/ton | |

Table A-2
Sulfur Oxide Emissions in New York City Metropolitan Area

| County or City | Grand Total | Tons/Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Emissions by Source Category | | | | | | |
| | | From Fuel Burning | | | | | | |
| | | Residential | Commercial & Government | Industrial | Power Plants | Transportation | Industrial Processes | Refuse Disposal |
| Bergen | 89929 | 11159 | 13281 | 18146 | 46016 | 1207 | | 52 |
| Esse | 104174 | 18116 | 32829 | 35308 | 13555 | 1085 | | 12 |
| Hudson | 147908 | 10431 | 29129 | 37154 | 70371 | 553 | | 114 |
| Middlesex | 189312 | 6221 | 18313 | 45911 | 87904 | 788 | | 20 |
| Monmouth | 17476 | 5631 | 3001 | 8181 | ---- | 656 | | 7 |
| Morris | 21180 | 4208 | 8213 | 8226 | ---- | 522 | | 11 |
| Passaic | 31363 | 6318 | 10862 | 13600 | ---- | 554 | | 4 |
| Somerset | 22087 | 2264 | 4934 | 9365 | ---- | 1108 | | 3 |
| Union | 133454 | 8891 | 20957 | 36639 | 42604 | 734 | | 14 |
| New Jersey Total | 756883 | 73239 | 141519 | 212530 | 260448 | 7207 | | 237 |
| Bronx | 92750 | 49406 | 15597 | 4421 | 22555 | 564 | | 207 |
| Brooklyn | 196981 | 67962 | 42622 | 24622 | 60089 | 857 | | 830 |
| Staten Island | 23763 | 4184 | 2483 | 2909 | 14045 | 138 | | 4 |
| Manhattan | 227860 | 81035 | 19187 | 7667 | 118262 | 937 | | 772 |
| Queens | 193914 | 41510 | 28305 | 17327 | 104982 | 1687 | | 103 |
| Nassau | 57189 | 13555 | 4386 | 4050 | 33519 | 1259 | | 390 |
| Rockland | 10634 | 382 | 833 | 2673 | 6527 | 193 | | 26 |
| Westchester | 31377 | 11450 | 7854 | 6114 | 4835 | 894 | | 219 |
| New York Total | 834468 | 269484 | 121267 | 69783 | 364814 | 6529 | | 2551 |

Table A-3
Carbon Monixide Emissions in New York City Metropolitan Area
Tons/Year

| County or City | Grand Total | Emissions by Source Category | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | From Fuel Burning | | | | | | |
| | | Residential | Commercial & Government | Industrial | Power Plants | Transportation | Industrial Processes | Refuse Disposal |
| Bergen County | 493008 | 2173 | 56 | 90 | 468 | 490211 | | 10 |
| Essex County | 469028 | 7187 | 138 | 90 | 57 | 461480 | | 76 |
| Hudson County | 234026 | 3651 | 73 | 1868 | 585 | 227778 | | 71 |
| Middlesex County | 387551 | 1482 | 24 | 540 | 610 | 230146 | | 49 |
| Monmouth County | 196453 | 1073 | 5 | 25 | --- | 195350 | | Neg. |
| Morris County | 164981 | 1120 | 19 | 37 | --- | 163783 | | 22 |
| Passaic County | 198690 | 2524 | 41 | 1338 | --- | 194733 | | 54 |
| Somerset County | 68255 | 575 | 245 | 2729 | --- | 64701 | | 5 |
| Union County | 298087 | 3118 | 74 | 133 | --- | 293562 | | 350 |
| New Jersey Total | 2510079 | 22903 | 675 | 6850 | 1720 | 2321744 | | 637 |
| Bronx | 220175 | 3146 | 1024 | 40 | 2 | 212095 | | 3868 |
| Brooklyn | 353271 | 4161 | 1834 | 39 | 216 | 341052 | | 5969 |
| Staten Island | 48272 | 193 | 771 | 6 | 335 | 46646 | | 321 |
| Manhattan | 381504 | 4359 | 1658 | 20 | 1121 | 368764 | | 5582 |
| Queens | 625314 | 1353 | 1283 | 22 | 964 | 617920 | | 3772 |
| Nassau | 612120 | 1392 | 178 | 30 | 153 | 610030 | | 337 |
| Rockland | 98828 | 105 | 15 | 102 | 88 | 96051 | | 17 |
| Westchester | 448920 | 1152 | 163 | 99 | --- | 447093 | | 413 |
| New York Total | 2786404 | 15861 | 6926 | 358 | 2879 | 2740101 | | 20279 |

Table A-4

Particulate Emissions in New York City Metropolitan Area

Tons/Year

| County or City | Grand Total | Emissions by Source Category | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | From Fuel Burning | | | | | | |
| | | Residential | Commercial & Government | Industrial | Power Plants | Transportation | Industrial Processes | Refuse Disposal |
| Bergen County | 14460 | 2940 | 1020 | 2246 | 3468 | 2962 | 1160 | 664 |
| Essex County | 12242 | 3337 | 24 | 1008 | 1036 | 2758 | 996 | 983 |
| Hudson County | 18751 | 2107 | 1347 | 7315 | 3247 | 1361 | 2548 | 826 |
| Middlesex County | 23338 | 1644 | 1068 | 5668 | 6856 | 1987 | 5705 | 408 |
| Monmouth County | 4302 | 1421 | 362 | 181 | ---- | 1654 | 332 | 352 |
| Morris County | 4618 | 1053 | 475 | 1426 | ---- | 1309 | 110 | 245 |
| Passaic County | 6964 | 1425 | 627 | 2724 | ---- | 1381 | 381 | 426 |
| Somerset County | 4105 | 583 | 449 | 947 | ---- | 725 | 1264 | 137 |
| Union County | 11182 | 1913 | 1001 | 1936 | 1028 | 1878 | 2055 | 1371 |
| New Jersey Total | 99962 | 16423 | 8473 | 23451 | 15635 | 16015 | 14553 | 5412 |
| Bronx | 12915 | 4332 | 1603 | 675 | 648 | 1567 | 35 | 4055 |
| Brooklyn | 25950 | 7044 | 3282 | 1411 | 2681 | 2409 | 255 | 8868 |
| Staten Island | 3170 | 418 | 688 | 157 | 948 | 378 | 360 | 221 |
| Manhattan | 31593 | 5792 | 2087 | 787 | 9750 | 2617 | 230 | 10330 |
| Queens | 22020 | 3926 | 1999 | 975 | 6029 | 5389 | 347 | 3355 |
| Nassau | 13629 | 1754 | 404 | 1013 | 1524 | 3580 | 189 | 5165 |
| Rockland | 8017 | 115 | 251 | 890 | 2714 | 494 | 3248 | 305 |
| Westchester | 12982 | 1269 | 909 | 4240 | 113 | 2211 | 697 | 3543 |
| New York Total | 130276 | 24650 | 11223 | 10148 | 24407 | 18643 | 5361 | 35842 |

TABLE A-5. EMISSIONS IN SOUTHWESTERN CONNECTICUT–TONS/YEAR

| SMSA | SULFUR OXIDE | | CARBON MONOXIDE | PARTICULATE | |
|---|---|---|---|---|---|
| | TOTAL | POWER PLANTS | TOTAL | TOTAL | POWER PLANTS |
| STAMFORD | 16700 | --- | 102000 | 3783 | --- |
| NORWALK | 57100 | 35200 | 60200 | 2519 | --- |
| BRIDGEPORT | 128400 | --- | 157400 | 6680 | --- |
| Milford Power Pl. | --- | 38600 | --- | --- | 1387 |
| Bridgeport Power Pl. | --- | 25300 | --- | --- | 949 |
| CONNECTICUT TOTAL | 203200 | 99100 | 319600 | 12982 | 2336 |

The emission data were converted to show mean-day emissions for annual, winter (December, January, February), and summer (June, July, August) seasons (Table A-6) to facilitate diffusion model calculations of mean-day concentrations for each of the three seasons. The conversion was accomplished by apportioning variable emissions to each of the seasons in accordance with information on monthly heating-degree days and then calculating the average-day emissions for each season.

TABLE A-6. MEAN DAY EMISSIONS FOR VARIOUS AVERAGING TIMES
(TONS)

| County or City | Suflur Dioxide | | | Carbon Monoxide | | | Particulates | | |
|---|---|---|---|---|---|---|---|---|---|
| | Annual | Winter | Summer | Annual | Winter | Summer | Annual | Winter | Summer |
| Bergen Co. | 246 | 332 | 178 | 1,366 | 1,295 | 1,430 | 30 | 42 | 21 |
| Essex Co. | 283 | 464 | 140 | 1,301 | 1,230 | 1,360 | 31 | 47 | 18 |
| Hudson Co. | 404 | 551 | 288 | 645 | 615 | 680 | 43 | 52 | 35 |
| Middlesex Co. | 517 | 619 | 437 | 1,074 | 1,020 | 1,120 | 26 | 28 | 24 |
| Monmouth Co. | 45 | 72 | 23 | 544 | 515 | 570 | 12 | 17 | 8 |
| Morris Co. | 58 | 101 | 23 | 459 | 435 | 480 | 13 | 18 | 9 |
| Passaid Co. | 85 | 147 | 36 | 550 | 520 | 575 | 16 | 21 | 12 |
| Somerset Co. | 60 | 88 | 38 | 190 | 180 | 200 | 11 | 14 | 9 |
| Union Co. | 365 | 480 | 274 | 826 | 785 | 860 | 21 | 26 | 18 |
| New Jersey Subtotal | 2,063 | 2,854 | 1,437 | 6,955 | 6,595 | 7,275 | 202 | 264 | 153 |
| Bronx Bor. | 252 | 433 | 109 | 610 | 580 | 635 | 35 | 49 | 25 |
| Kings Co. (Brooklyn) | 535 | 895 | 251 | 980 | 930 | 1,020 | 62 | 83 | 45 |
| Nassau Co. | 156 | 213 | 112 | 1,699 | 1,610 | 1,775 | 34 | 42 | 29 |
| New York Co. (Manh.) | 621 | 888 | 410 | 1,057 | 1,000 | 1,105 | 57 | 65 | 51 |
| Queens Bor. | 529 | 762 | 345 | 1,735 | 1,645 | 1,810 | 41 | 66 | 21 |
| Richmond Co. | 64 | 88 | 45 | 134 | 125 | 140 | 9 | 12 | 6 |
| Rockland Co. | 29 | 34 | 25 | 274 | 260 | 285 | 12 | 14 | 10 |
| Westchester Co. | 85 | 165 | 38 | 1,245 | 1,180 | 1,300 | 27 | 35 | 20 |
| Suffolk Co. | - | - | - | - | - | - | - | - | - |
| New York Subtotal | 2,271 | 3,458 | 1,335 | 7,734 | 7,330 | 8,070 | 277 | 366 | 207 |
| Stamford SMSA | 46 | 69 | 27 | 284 | 270 | 295 | 11 | 13 | 8 |
| Norwalk SMSA | 157 | 234 | 94 | 168 | 160 | 175 | 7 | 9 | 6 |
| Bridgeport SMSA | 355 | 531 | 213 | 436 | 415 | 455 | 18 | 21 | 16 |
| AREA TOTALS | 4,892 | 7,146 | 3,106 | 15,577 | 14,770 | 17,070 | 515 | 673 | 390 |

## References for Appendix A.

1. Technical Report, New York-New Jersey Air Pollution Abatement Activity, Phase I--pp. 38-57, Appendix C; Phase II--pp. 45-71, Appendix C; January, 1967, December, 1967, resp., USDHEW, PHS.

2. "Rapid Survey Technique for Estimating Community Air Pollution Emissions," PHS, Publication No. 999-AP-29, Environmental Health Series, USDHEW, NCAPC, Cincinnati, Ohio, October, 1966.

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## APPENDIX B. DIFFUSION MODEL DESCRIPTION AND RESULTS

Title I, Section 107 (a) (2) of the Air Quality Act of 1967 (Public Law 90-148, dated November 21, 1967), calls for the designation of air quality control regions, based on a number of factors, including "atmospheric conditions", interpreted to mean that the boundaries of air quality control regions should reflect the technical aspects of air pollution and its dispersion. Within this guideline, however, the position has been taken that region boundaries cannot be based on an extreme set of circumstances which might have a theoretical chance of occurence. Hence the analysis of a region's atmospheric dilution potential is largely based on mean annual values, although summer and winter mean values are analyzed with respect to reviewing seasonal variations in meteorology and pollutant emissions.

With the realization that the meteorological analysis would help define tentative boundaries only and that final boundaries would be developed subsequently to reflect local government aspects, it was decided that the meteorological assessment should be as unpretentious as possible. Accordingly, the widely accepted long-term Gaussian diffusion equation, described by Pasquill[1], has been applied with a few modifications to accomodate certain requirements inherent to the delineation of air quality control regions. These modifications are discussed in the next section. In summary, the Gaussian diffusion equation is utilized to provide a theoretical estimate of the

geographical distribution of long-period mean ground-level concentrations of $SO_X$, CO, and suspended particulates. The model used has the necessary flexibility to utilize information on emissions from both point and area-wide sources.

To maintain simplicity, all pollutant sources were assumed to be at ground level; for CO this assumption is realistic. The same assumption is used for major point sources of $SO_X$ and particulates, since the distances of interest are sufficiently great to obviate the source-height effect for most receptors. Also, since there is no agreement to what an appropriate half-life and deposition rate for $SO_X$ and particulates, respectively, these factors were not applied to the computations of ground-level pollutant concentrations during the initial diffusion model analysis. As discussed earlier in the report (page35) and briefly below, certain modifications have been applied to the theoretical model results to allow comparative interpretation.

METHODOLOGY

The diffusion model used to compute theoretical long-term average pollutant concentration distributions for respective pollutants is based on Pasquill's Gaussian diffusion equation[1], as modified by Martin[2]. Essentially, the diffusion model sums the effects (ground-level concentration) of a number of sources (area and point) for a specified number of receptors, averaged over a season or a year; the receptor points are at distances of 20,30,40,50,70, and 100 kilometers

from a defined central grid point for each of 16 compass directions. An average pollutant concentration is computed for the central grid receptor (designated in the downtown or central city area) for comparison to air quality measurements that might be available.

The meteorological data input to the model is screened to determine the representiveness of the data. Appropriate surface wind rose data are selected from U.S. Weather Bureau records; if necessary, special wind data tabulations are obtained from the National Weather Records Center (NWRC). The mean mixing depth for each region, for each respective time period (seasonal and average), is determined on the basis of computed mixing depths documented by Holzworth[4,5] and recent tabulations furnished the Meteorology Program by the National Weather Records Center (ESSA).

RESULTS

A comparison of calculated concentrations of CO to air quality data for the New York City metropolitan area shows reasonable agreement in relative terms, but the model consistently underestimates the concentration in comparison to measured values in the central urban area[6]. As is discussed in the text of this report, an empirically derived correction factor has been applied to the output to allow comparative use of the CO data.

For $SO_X$ the initial model calculations were systematically higher than measured calculations. This over-calculation is thought to result from the fact that $SO_X$ reacts in the atmosphere, leading to

concentrations lower than those predicted by the model. As discussed in the body of this report, three "decay factors" representing arbitrary half-life assumptions of 3, 6, and 12 hours have been applied to the theoretical model output to aid in the analysis.

For suspended particulates, the model gave relatively good results when the finite values were compared to measured concentrations in and around the center of the proposed New York City region. The good correlation seems to be the result of two apparently compensating limitations of the model. The model estimates for suspended particulates are also interpreted in this report in a relative sense.

Figures B-1 through B-3 present unmodified $SO_X$ results for the three time periods and, B-4 through B-6, $SO_X$ results as modified by three half-life assumptions. Figure B-7 shows theoretical 0.01 ppm contour lines for $SO_X$ for the three half-life assumptions. Figures B-8 through B-13 show diffusion model results for CO and suspended particulates for the three time periods investigated.

The model results can be appropriately modified and interpreted to provide reasonable spatial distributions of long-term (seasonal and annual averages) pollutant concentrations resulting from the release of pollutants within a region.

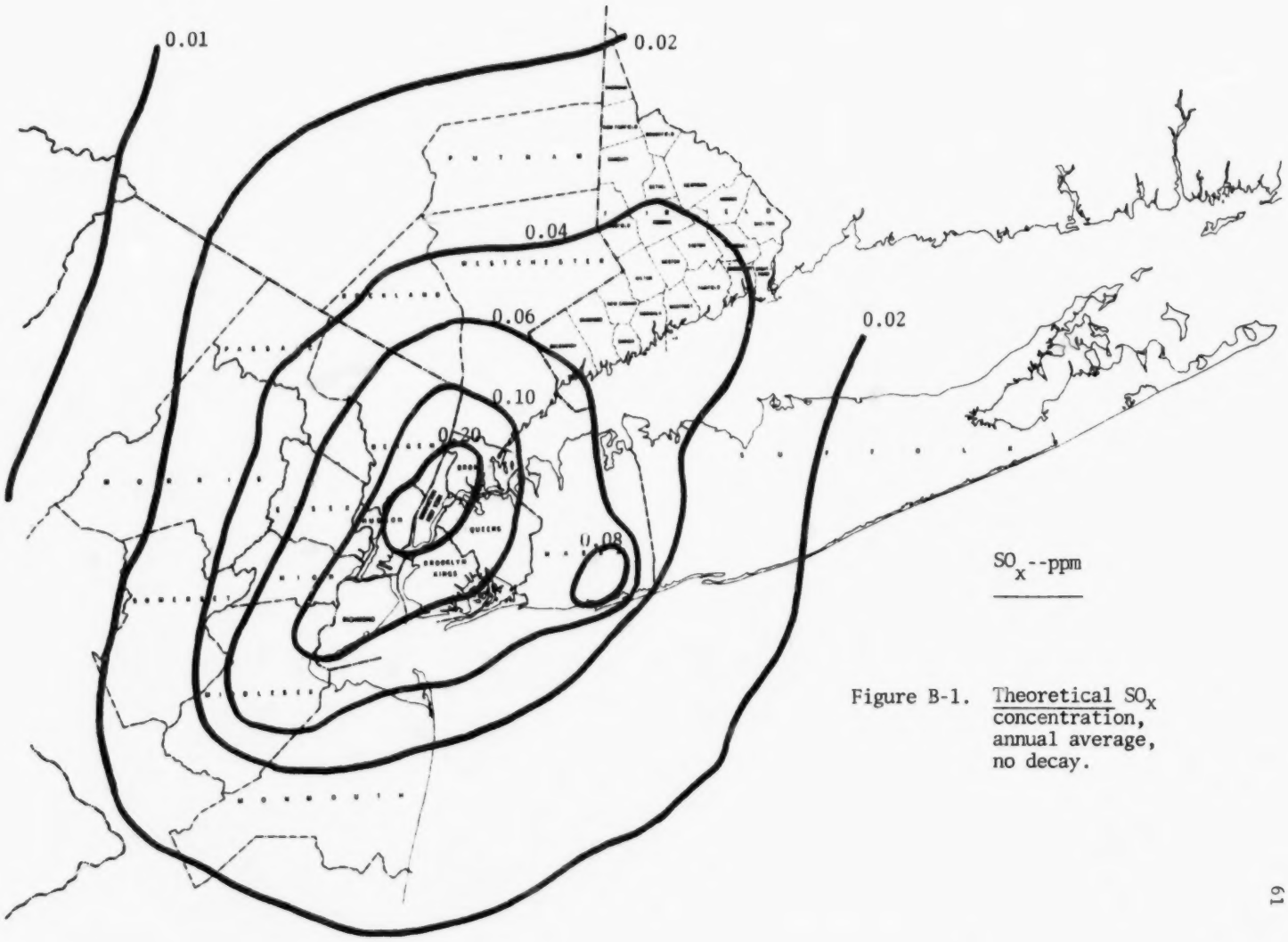
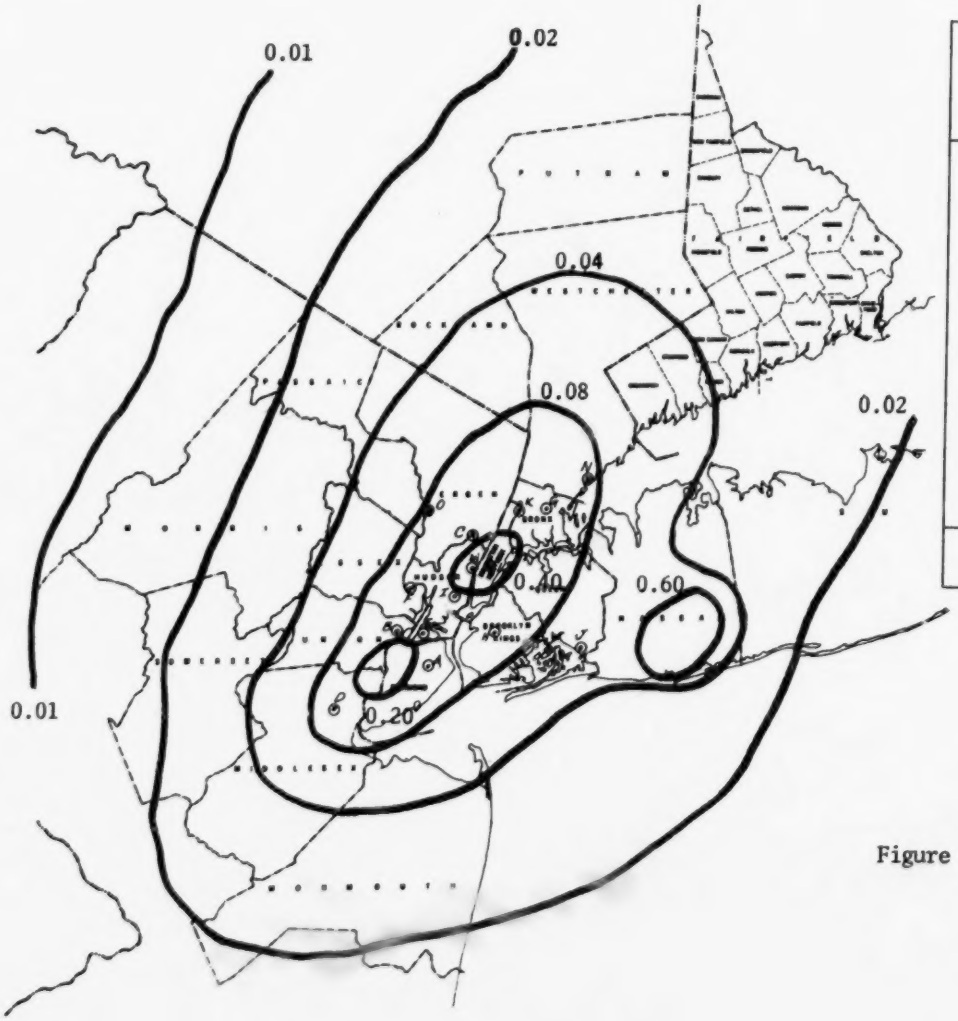



Figure B-1. Theoretical $SO_x$ concentration, annual average, no decay.




| Station | Concentration measured[6] (M) | Concentration Estimated (E) | Ratio E/M |
|---|---|---|---|
| A | 0.05 | 0.18 | 3.60 |
| B | 0.03 | 0.18 | 6.00 |
| C | 0.05 | 0.40 | 8.00 |
| D | 0.10 | 0.10 | 1.00 |
| E | 0.09 | 0.16 | 1.78 |
| F | 0.08 | 0.12 | 1.50 |
| G | 0.08 | 0.21 | 2.63 |
| H | 0.05 | 0.11 | 2.20 |
| I | 0.06 | 0.30 | 5.00 |
| J | 0.05 | 0.05 | 1.00 |
| K | 0.08 | 0.30 | 3.75 |
| L | 0.05 | 0.42 | 8.40 |
| M | 0.08 | 0.40 | 5.00 |
| N | 0.03 | 0.09 | 3.00 |
| O | 0.07 | 0.08 | 1.14 |
| TOTAL | | | 54.00 |
| 54.00/15=3.60 | | | |

$SO_X$--ppm

Figure B-2. Theoretical $SO_X$ concentration, summer average, no decay.

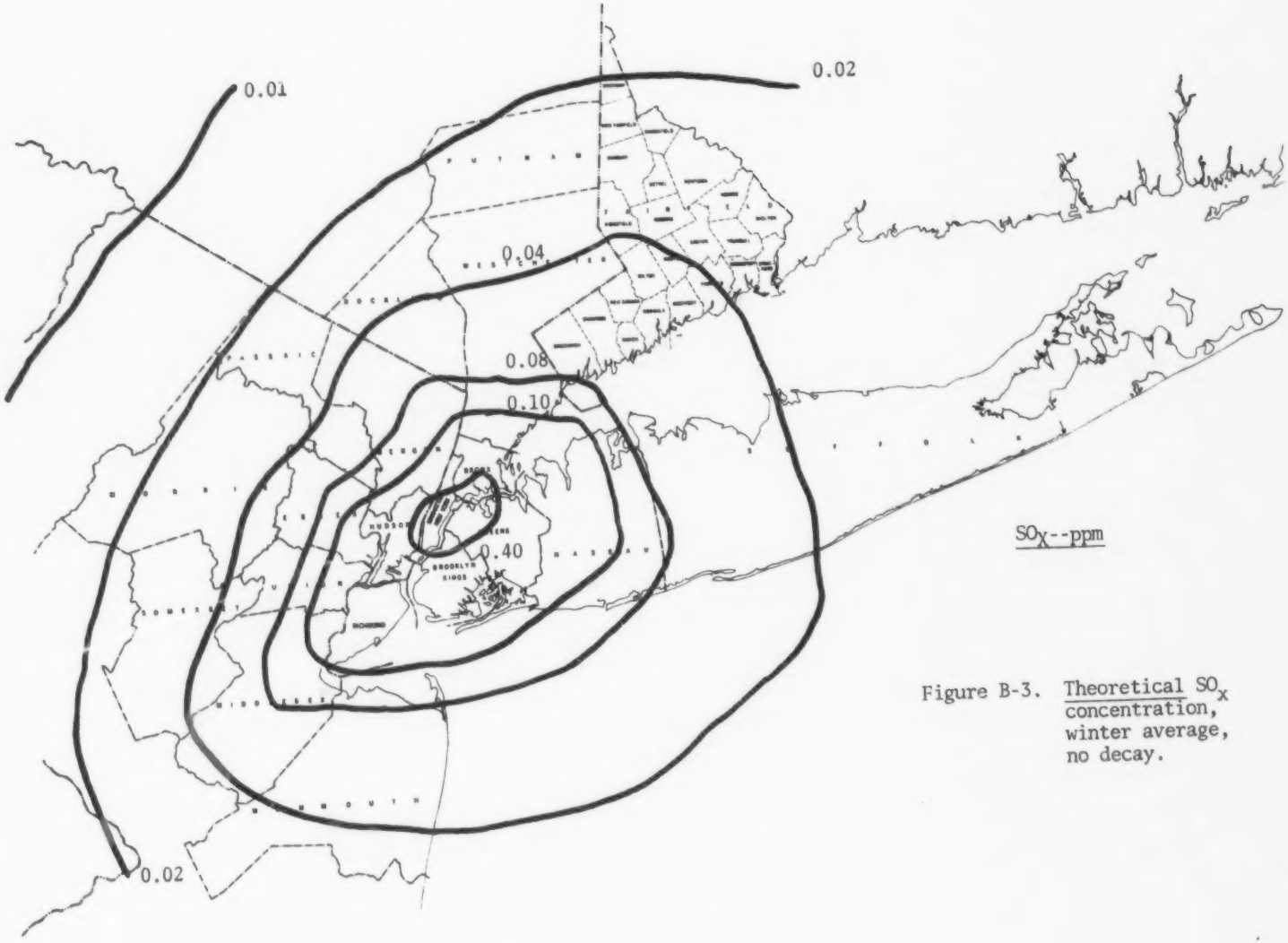



Figure B-3. Theoretical $SO_X$ concentration, winter average, no decay.

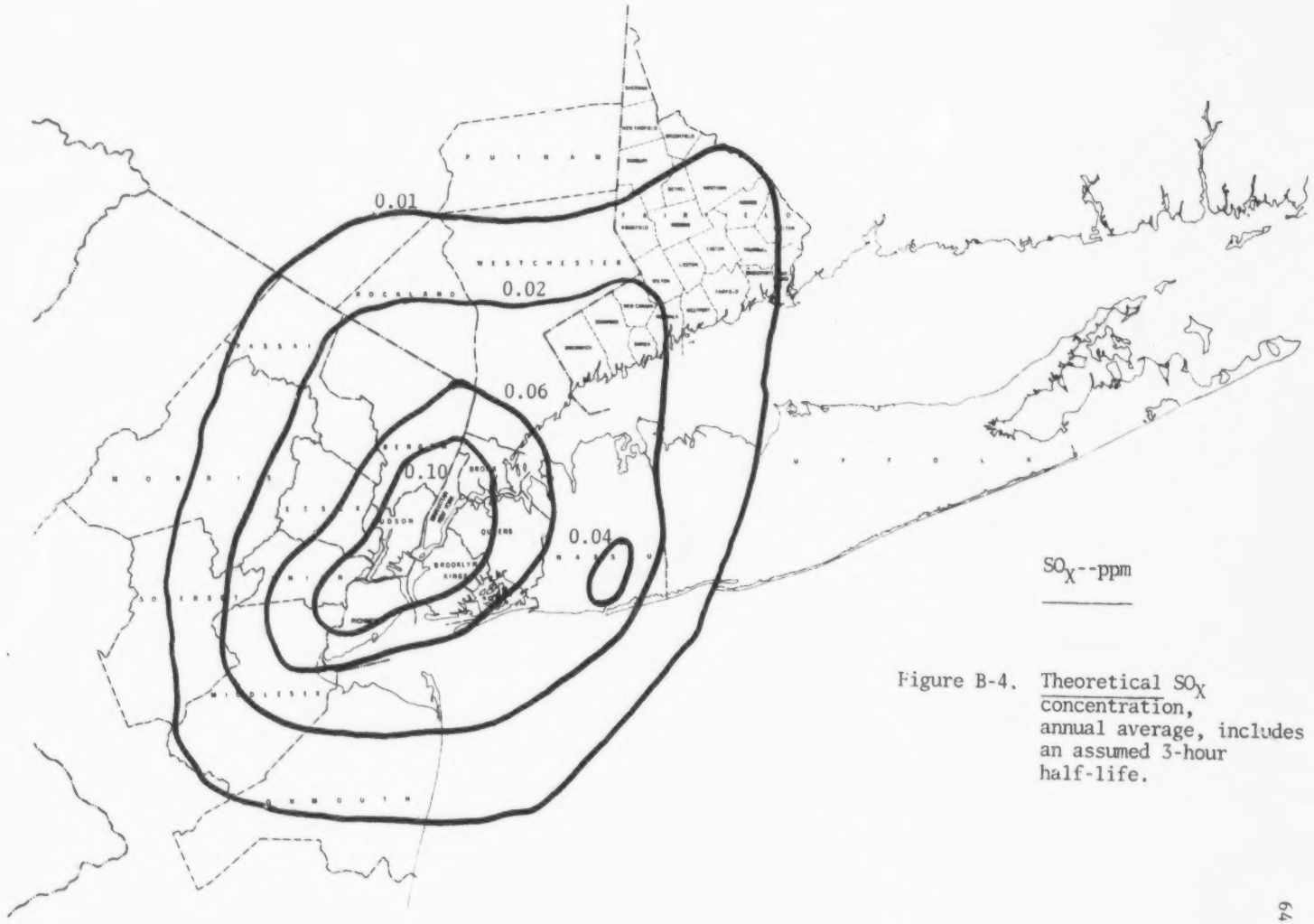



Figure B-4. Theoretical $SO_X$ concentration, annual average, includes an assumed 3-hour half-life.

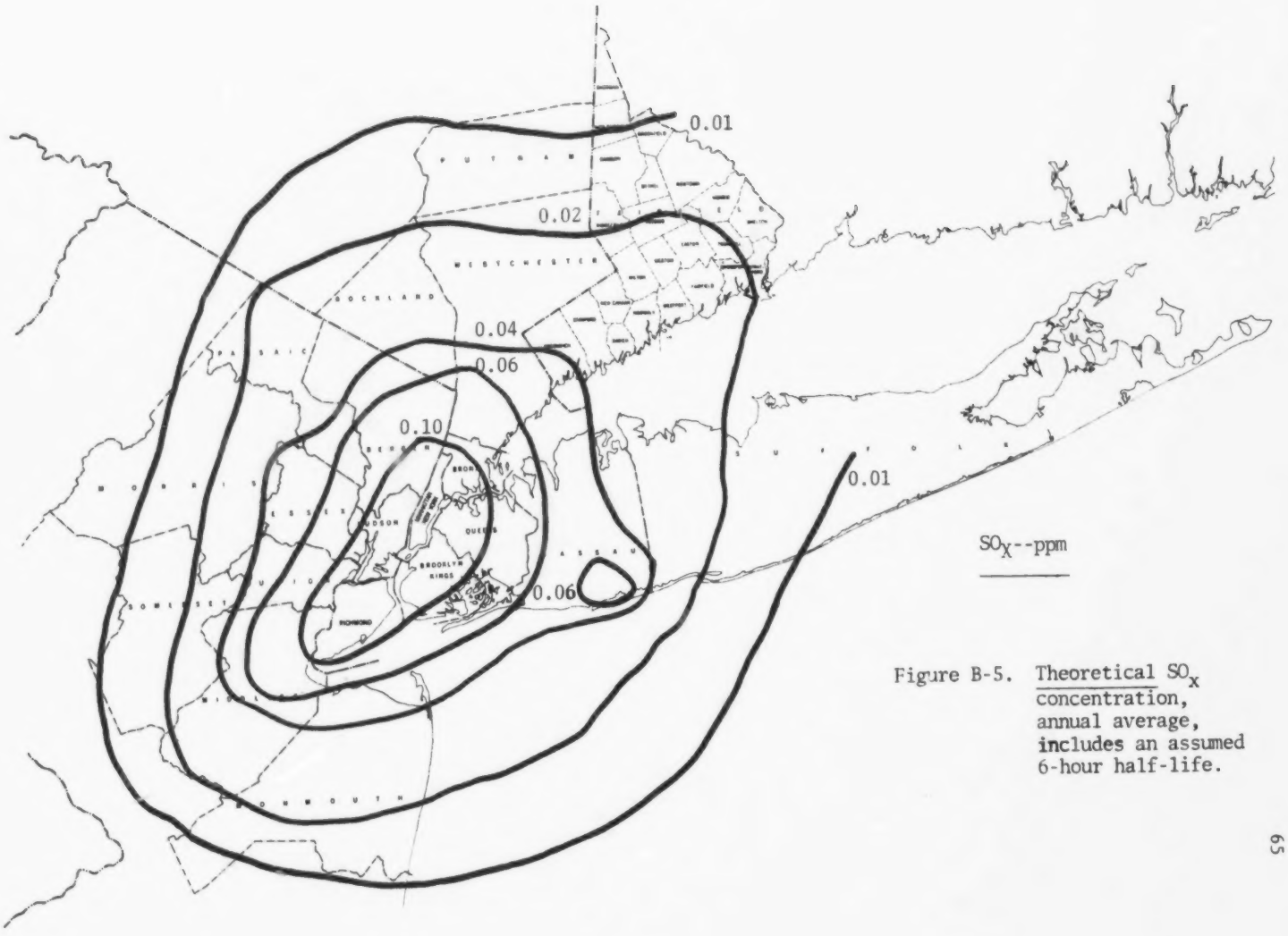



Figure B-5. Theoretical $SO_X$ concentration, annual average, includes an assumed 6-hour half-life.

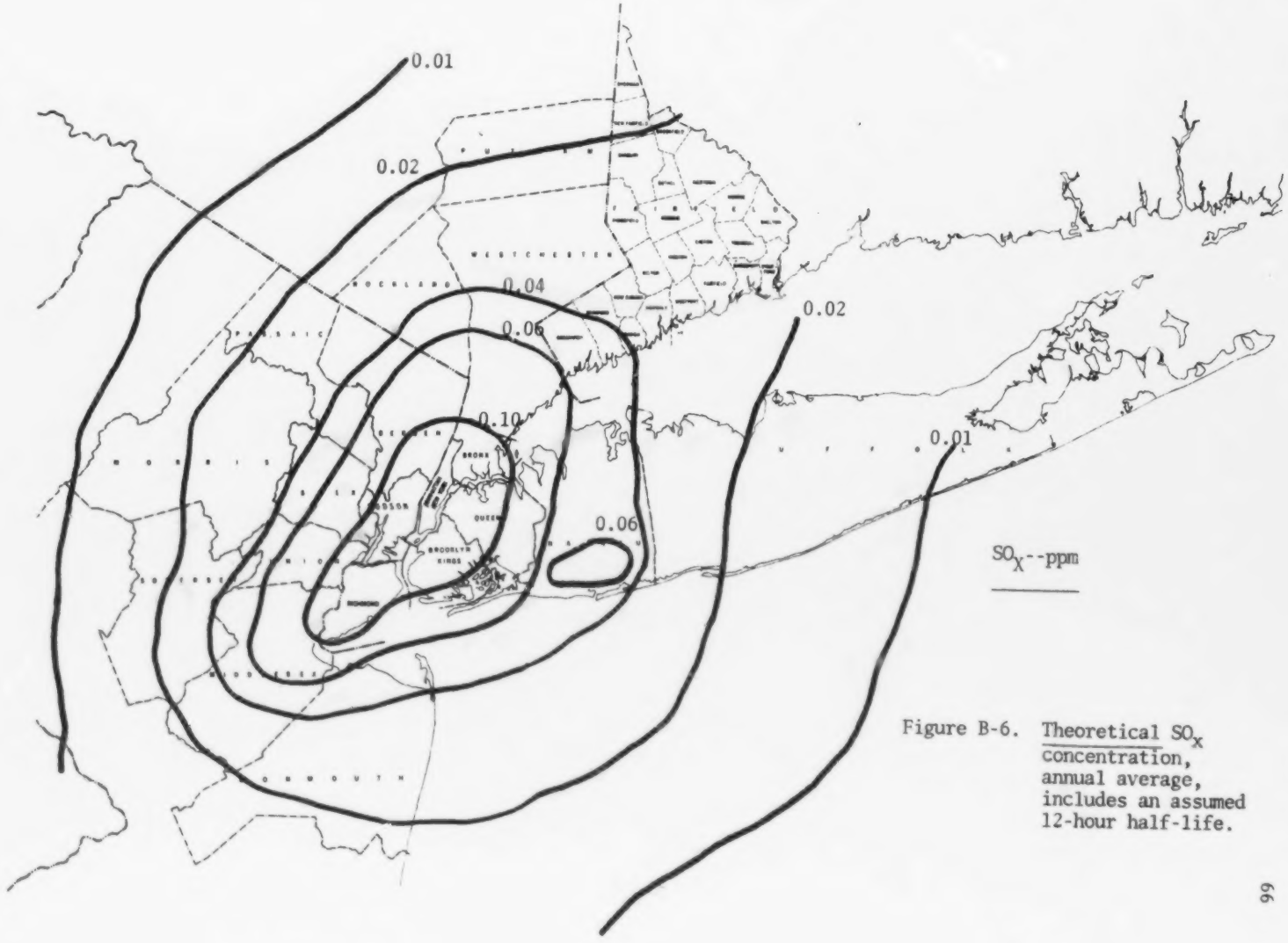



Figure B-6. Theoretical $SO_X$ concentration, annual average, includes an assumed 12-hour half-life.

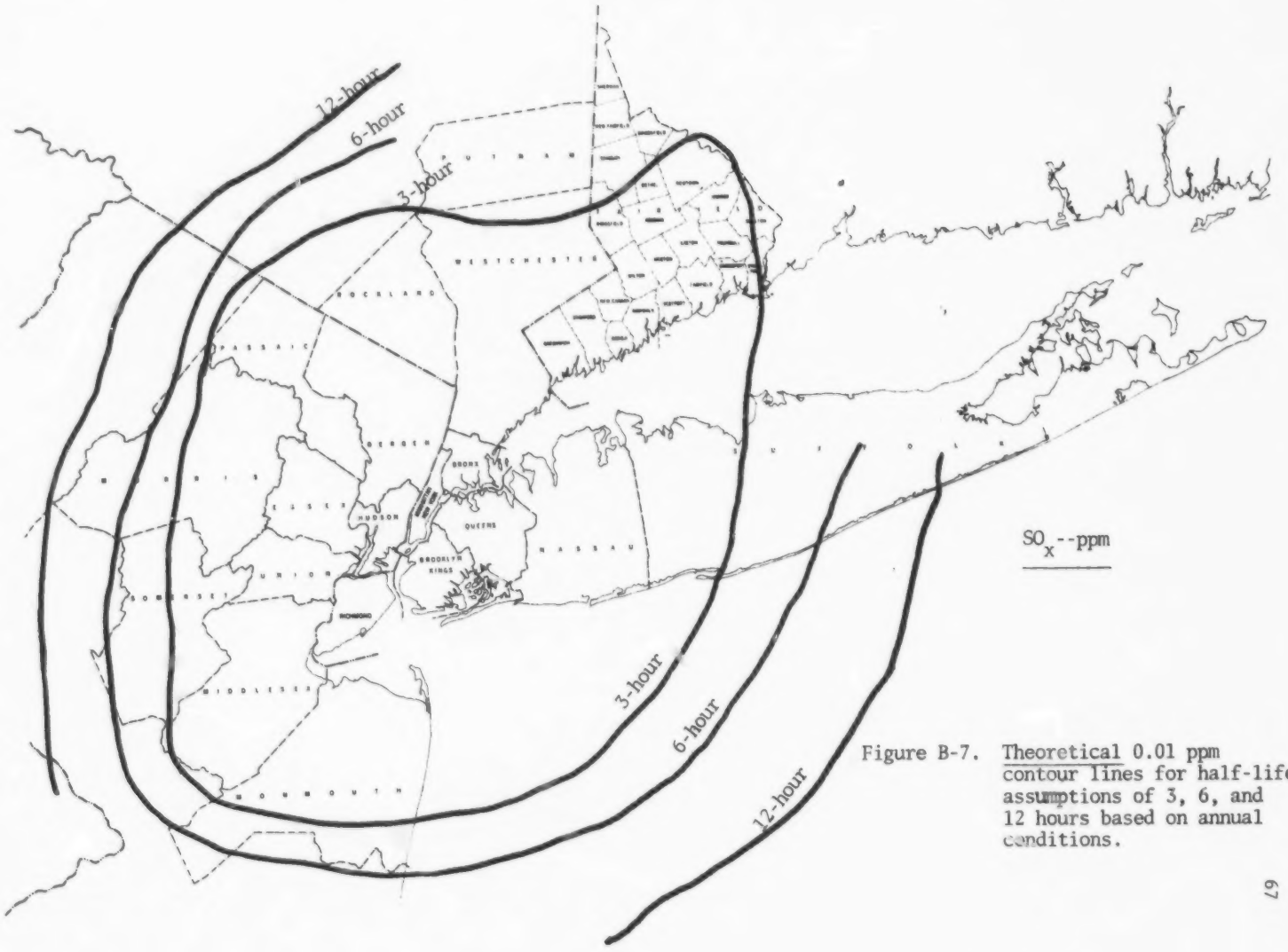



Figure B-7. Theoretical 0.01 ppm contour lines for half-life assumptions of 3, 6, and 12 hours based on annual conditions.

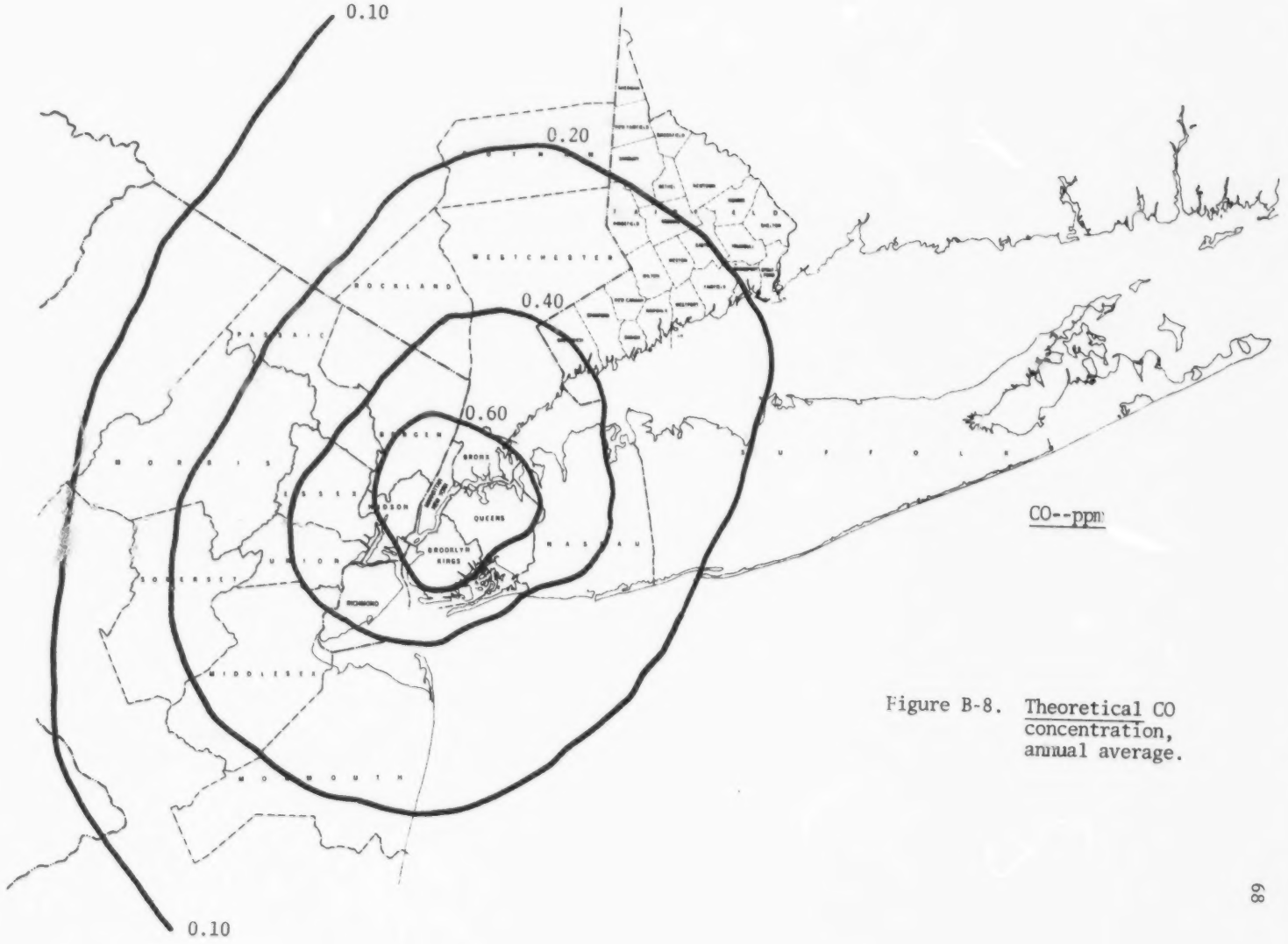
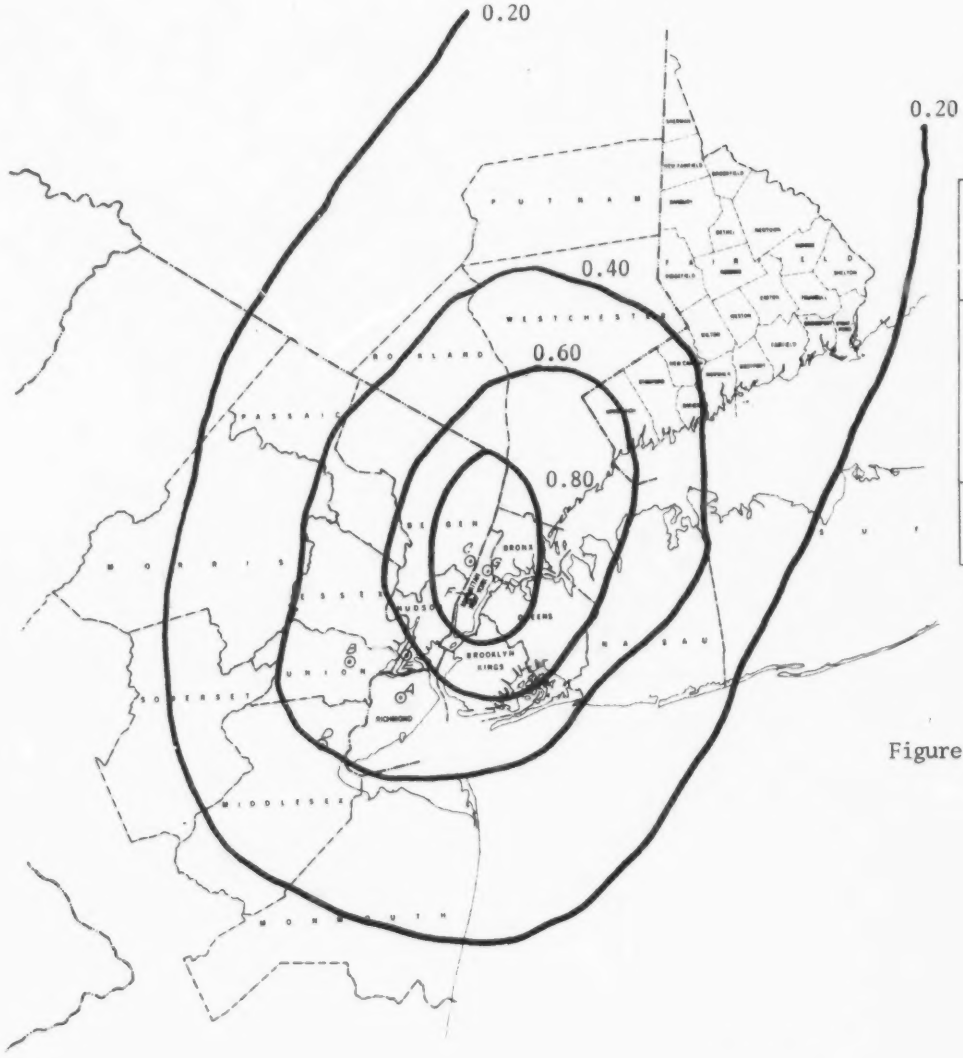



Figure B-8. Theoretical CO concentration, annual average.




| Station | Concentration Measured (M) | Concentration Estimated (E) | Ratio M/E |
|---|---|---|---|
| A | 2 | 0.53 | 3.8 |
| B | 6 | 0.54 | 11.1 |
| C | 3 | 1.25 | 2.4 |
| D | 2 | 0.40 | 5.0 |
| E | 2 | 0.70 | 2.9 |
| F | 5 | 1.25 | 4.0 |
| G | 3 | 1.25 | 2.4 |
| TOTAL | | | 31.6 |
| | | 31.6/7=4.51 | |

CO--ppm

Figure B-9. Theoretical CO concentration, summer average.

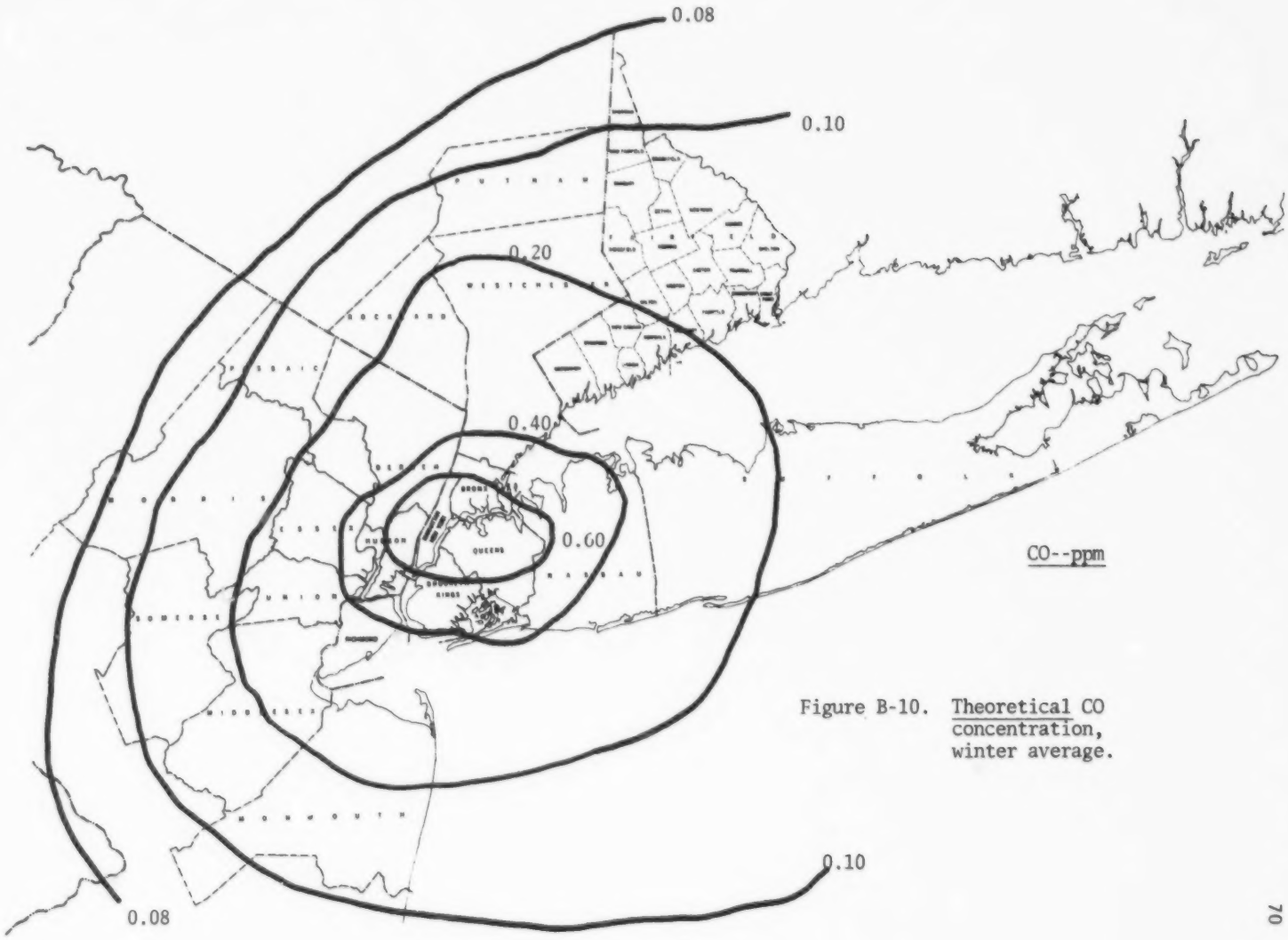



Figure B-10. Theoretical CO concentration, winter average.

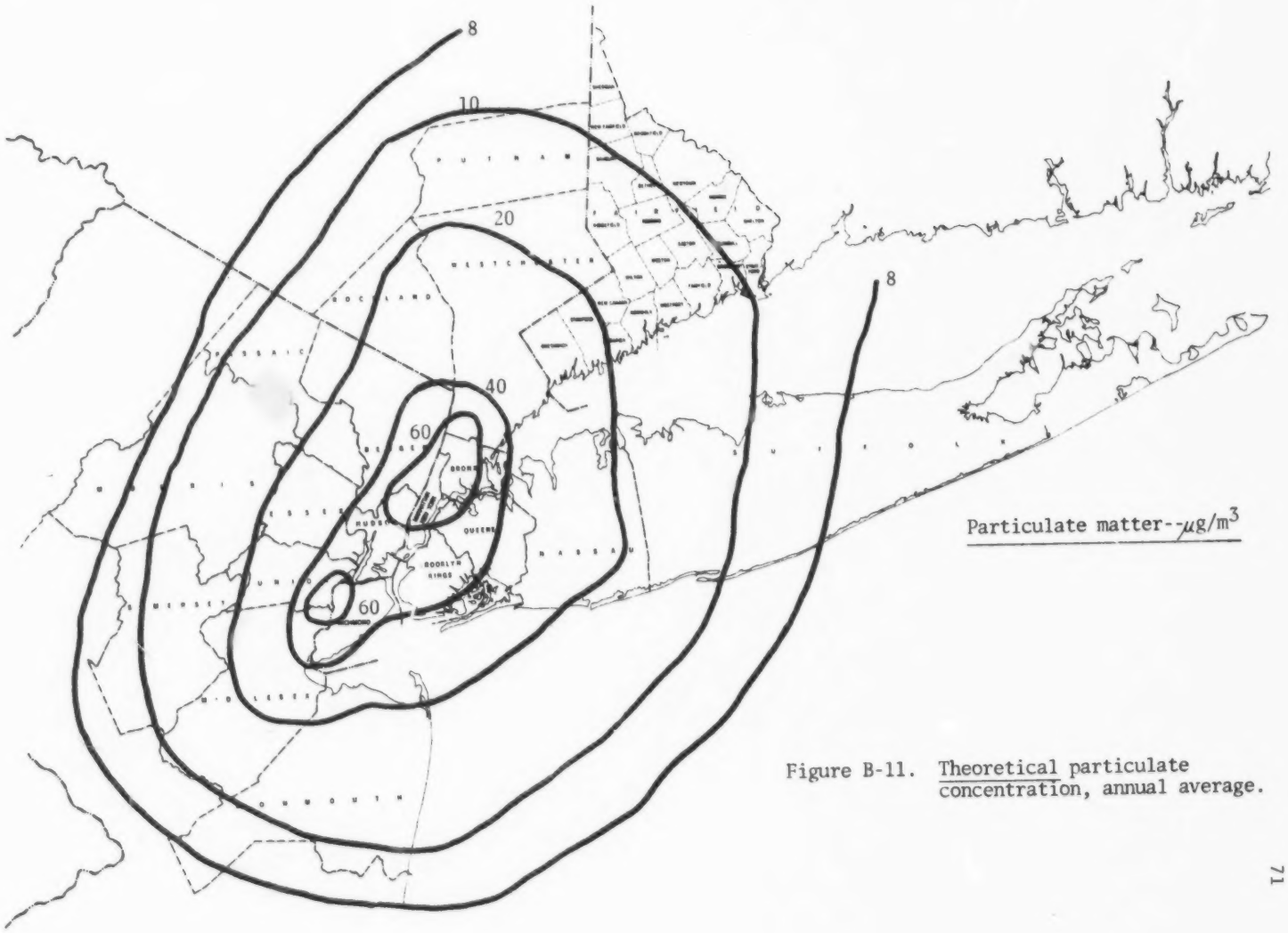



Figure B-11. Theoretical particulate concentration, annual average.

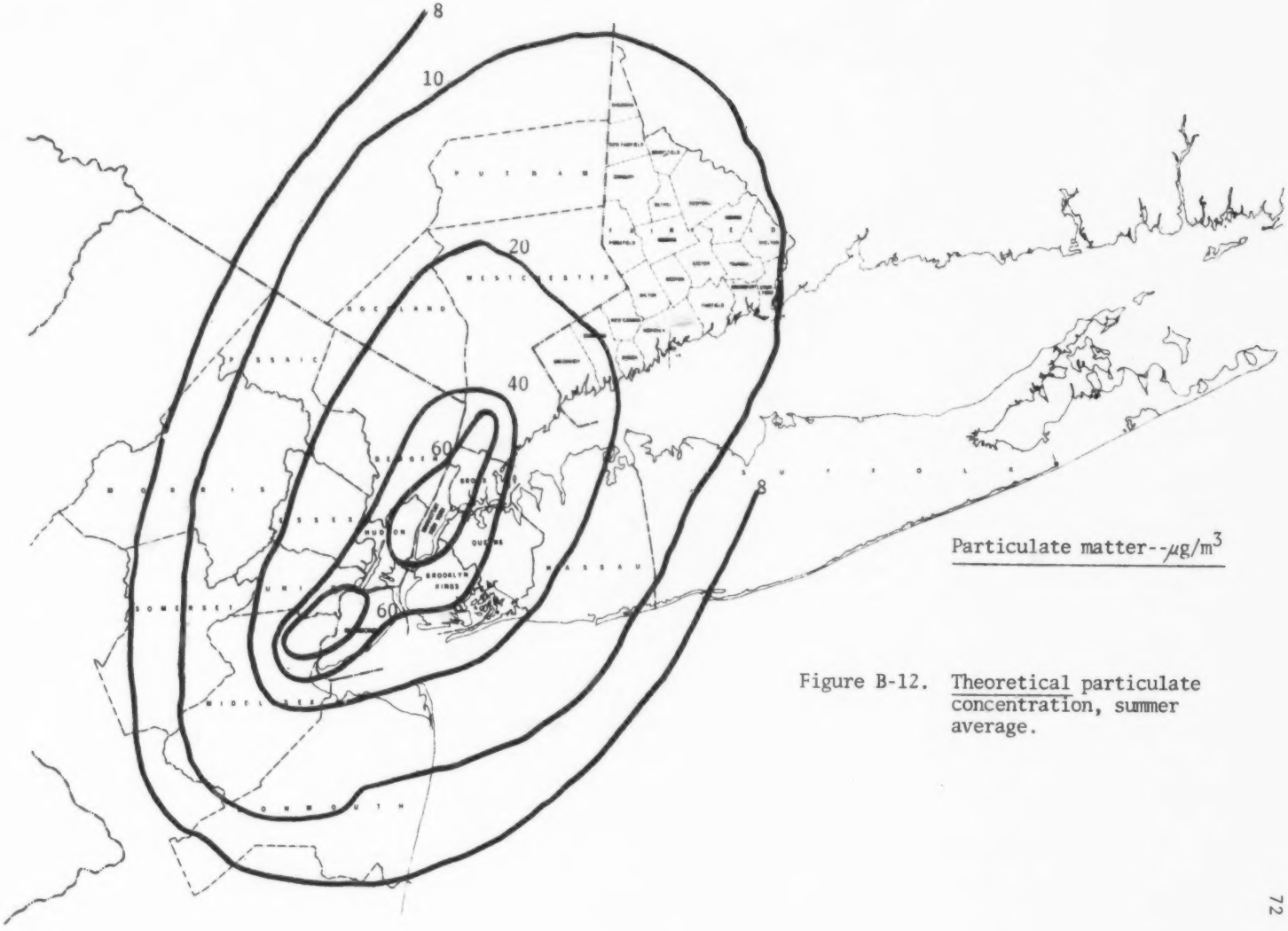



Figure B-12. Theoretical particulate concentration, summer average.

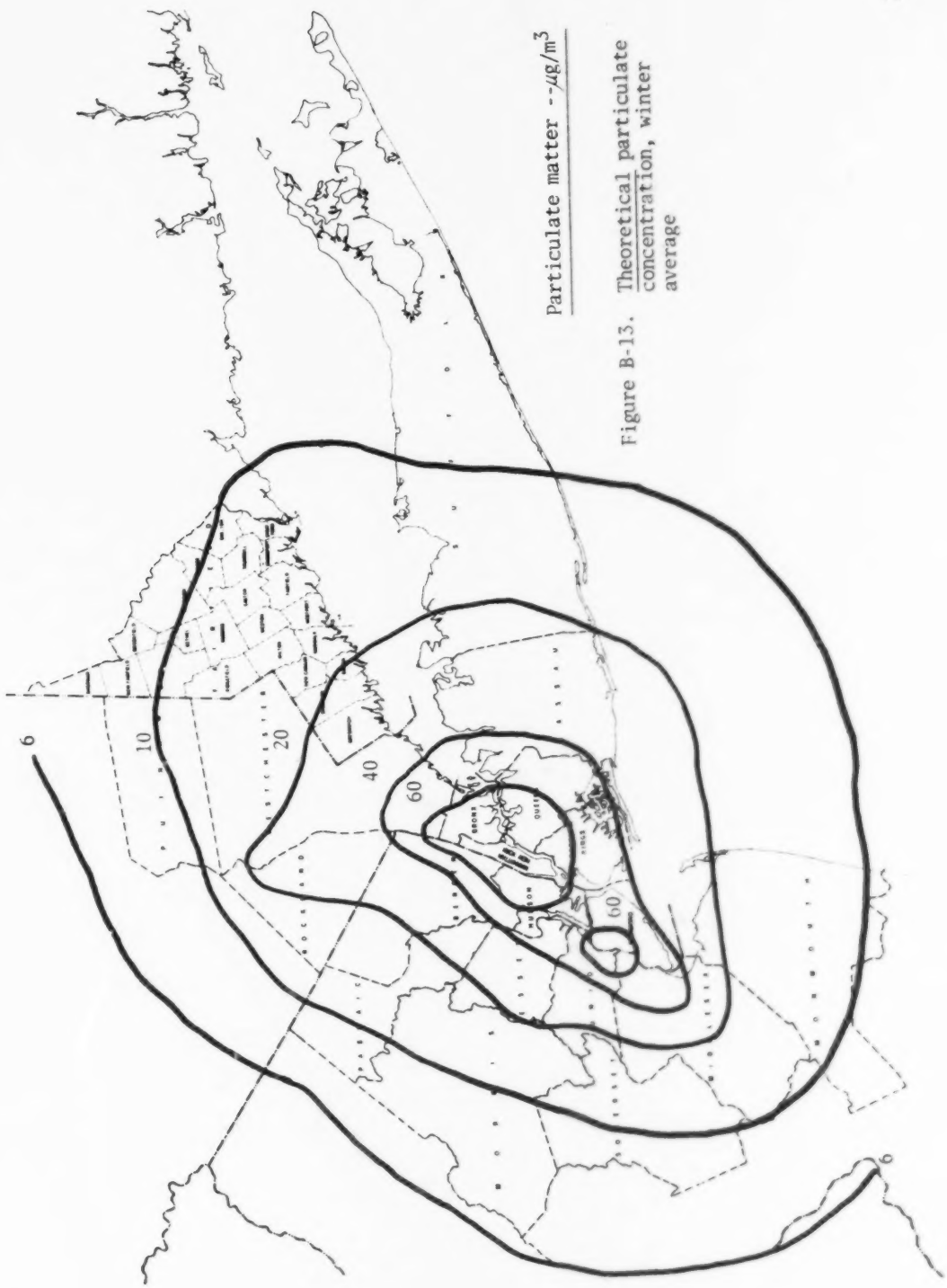



Figure B-13. Theoretical particulate concentration, winter average

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## References for Appendix B.


1. Pasquill, F. "The Estimation of the Dispersion of Windborn Material," Meteorology Magazine, 90, 1963, pp. 33-49.

2. Martin, D. O., "A General Atmospheric Diffusion Model for Estimating the Effects on Air Quality of One or More Sources", paper no. 68-148, 61st Annual Meeting, APCA, St. Paul, Minnesota, June, 1968.

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4. Holzworth, G. C., "Mixing depths, wind speeds and air pollution potential for selected locations in the United States, J. Appl. Meteor., No. 6, December, 1967, pp. 1039-1044.

5. Holzworth, G. C., "Estimates of mean maximum mixing depths in the contiguous United States," Mon. Weather Rev. 92, No. 5, May, 1964, pp. 235-242.

6. Technical Report, New York-New Jersey Air Pollution Abatement Activity, Phase I--Sulfur Compounds and Carbon Monoxide, January, 1967; Phase II--Particulate Matter, December, 1967; USDHEW, PHS.

## APPENDIX C. DEMOGRAPHIC DATA

This appendix consists of tables and charts showing various parameters of the New Jersey-New York-Connecticut urban area. Some of this data is referred to in the body of this report, and some is not. All has relevance to the tri-State area and is included in this report for possible future use.

## Appendex C
## Contents of Demographic Data


| | | |
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| Table C-1 to C-13 | Current Population & Sales Data ..... | 77-89 |
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| Table C-16 to C-18 | New York State, County Population Density.. | 92-94 |
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Table C-1. New Jersey-New York-Connecticut
AIR QUALITY CONTROL REGION

| County | Fairfield, Conn. | Bronx, N.Y. | Kings, N.Y. | Nassau, N.Y. |
|---|---|---|---|---|
| County Seat | None | Bronx | Brooklyn | Mineola |
| Basic Trading Area | Bridgeport<br>Stamford<br>Danbury | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Land Area (Sq. miles) | 626 | 41 | 70 | 289 |
| Population (1950) | 504,342 | 1,451,277 | 2,738,175 | 672,765 |
| (1960) | 653,589 | 1,424,815 | 2,627,319 | 1,300,171 |
| est. (1968) | 777,000 | 1,520,000 | 2,670,000 | 1,450,000 |
| Households (1968 est.) | 231,300 | 495,100 | 864,100 | 388,700 |
| Total Retail Trade 1966 ($1000) | 1,456,120 | 1,334,917 | 2,914,732 | 2,762,035 |
| Shopping Goods Sales 1966 ($1000) | 253,425 | 267,223 | 599,504 | 715,877 |
| Food Store Sales 1966 ($1000) | 396,910 | 493,199 | 995,010 | 681,686 |
| Drug Store Sales 1966 ($1000) | 47,247 | 37,122 | 81,662 | 64,660 |
| Passenger Car Registrations | 376,130 | 456,310 | 31,750 | 622,690 |
| Total Wholesale Trade (1963) ($1000) | 884,406 | 1,078,953 | 2,5[illegible]4,643 | 1,9[illegible]0,267 |
| Manufactures 1963 | | | | |
| Total Employees | 11[illegible],425 | 56,400 | 219,060 | 97,613 |
| Value Added ($1000) | 1,280,135 | 473,464 | 2,127,556 | 1,132,168 |
| Agriculture: 1964 | | | | |
| Number of Farms | 408 | 6 | 14 | 187 |
| Total Value of Products Sold ($1000) | 5,553 | 77 | 395 | 6,848 |

Table C-2 New Jersey-New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| County | New York, N.Y. | Queens, N.Y. | Richmond, N.Y. | Rockland, N.Y |
|---|---|---|---|---|
| County Seat | New York | Jamaica | Staten Island | New City |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Land Area (Sq. miles) | 23 | 108 | 58 | 176 |
| Population (1950) | 1,960,101 | 1,550,849 | 191,555 | 89,276 |
| (1960) | 1,698,281 | 1,809,578 | 221,991 | 136,803 |
| est. (1968) | 1,580,000 | 1,970,000 | 280,000 | 208,000 |
| Households (1968 est.) | 647,500 | 635,500 | 77,800 | 52,800 |
| Total Retail Trade 1966 ($1000) | 4,821,907 | 2,309,044 | 271,874 | 218,034 |
| Shopping Goods Sales 1966 ($1000) | 1,702,473 | 421,239 | 44,679 | 33,419 |
| Food Store Sales 1966 ($1000) | 760,958 | 774,076 | 95,267 | 63,975 |
| Drug Store Sales 1966 ($1000) | 140,921 | 61,875 | 7,306 | 5,321 |
| Passenger Car Registrations | 191,980 | 541,650 | 80,940 | 77,360 |
| Total Wholesale Trade (1963)($1000) | 46,368,331 | 2,851,298 | 80,500 | 79,349 |
| Manufactures: 1963 | | | | |
| Total Employees | 509,249 | 133,140 | 9,564 | 12,127 |
| Value Added ($1000) | 4,713,283 | 1,416,943 | 130,496 | 257,162 |
| Agriculture: 1964 | | | | |
| Number of Farms | --- | 43 | 52 | 97 |
| Total Value of Products Sold ($1000) | --- | 1,404 | 719 | 1,547 |

Table C-3. New Jersey-New York-Connecticut[1]
AIR QUALITY CONTROL REGION

| County | Westchester,N.Y. | Suffolk,N.Y. | Putnam,N.Y. | Bergen,N.J. |
|---|---|---|---|---|
| County Seat | White Plains | Riverhead | Carmel | Hackensack |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Land Area (Sq. miles) | 443 | 929 | 231 | 234 |
| Population (1950) | 625,816 | 276,129 | 20,307 | 539,139 |
| (1960) | 808,891 | 666,784 | 31,722 | 780,255 |
| est. (1968) | 873,000 | 1,030,000 | 47,500 | 890,000 |
| Housholds (1968 est.) | 260,600 | 267,500 | 13,900 | 259,500 |
| Total Retail Trade 1966 ($1000) | 1,596,815 | 1,304,059 | 53,504 | 1,403,440 |
| Shopping Goods Sales 1966 ($1000) | 415,669 | 322,728 | 1,598 | 304,802 |
| Food Store Sales 1966 ($1000) | 400,636 | 341,343 | 14,374 | 379,754 |
| Drug Store Sales 1966 ($1000) | 36,582 | 30,738 | 1,751 | 36,513 |
| Passenger Car Registrations | 363,920 | 388,730 | 23,200 | 392,930 |
| Total Wholesale Trade (1963)($1000) | 2,218,220 | 384,901 | 7,903 | 2,708,335 |
| Manufactures 1963 | | | | |
| Total Employees | 66,543 | 43,507 | 945 | 95,891 |
| Value Added ($1000) | 755,095 | 431,176 | 9,416 | 1,162,265 |
| Agriculture: 1964 | | | | |
| Number of Farms | 231 | 1,138 | 122 | 270 |
| Total Value of Products Sold ($1000) | 4,960 | 48,713 | 1,474 | 5,515 |

Table C-4. New Jersey-New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| County | Essex, N.J. | Hudson, N.J. | Middlesex, N.J. | Monmouth, N.J. |
|---|---|---|---|---|
| County Seat | Newark | Jersey City | New Brunswick | Freehold |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Land Area (Sq. Miles) | 129 | 47 | 312 | 476 |
| Population (1950) | 905,949 | 647,437 | 264,872 | 225,327 |
| (1960) | 923,545 | 610,734 | 433,856 | 334,401 |
| est. (1968) | 975,000 | 607,000 | 564,000 | 437,000 |
| Households (1968 est.) | 301,900 | 195,200 | 152,400 | 123,100 |
| Total Retail Trade 1966 ($1000) | 1,638,122 | 822,106 | 721,226 | 605,123 |
| Shopping Goods Sales 1966 ($1000) | 419,656 | 167,215 | 173,330 | 114,495 |
| Food Store Sales 1966 ($1000) | 378,428 | 246,025 | 184,762 | 158,220 |
| Drug Store Sales 1966 ($1000) | 47,353 | 23,396 | 21,247 | 16,184 |
| Passenger Car Registrations | 400,210 | 214,170 | 194,530 | 168,210 |
| Total Wholesale Trade (1963) ($1000) | 2,753,880 | 1,121,303 | 611,198 | 178,469 |
| Manufactures 1963 | | | | |
| Total Employees | 126,489 | 109,534 | 76,364 | 20,759 |
| Value Added ($1000) | 1,373,277 | 1,385,223 | 1,074,307 | 204,410 |
| Agriculture: 1964 | | | | |
| Number of Farms | 73 | 8 | 388 | 927 |
| Total Value of Products Sold ($1000) | 886 | 241 | 10,717 | 21,189 |

Table C-5. New Jersey-New York-Connecticut[1] AIR QUALITY CONTROL REGION

| County | Morris, N.J. | Passaic, N.J. | Somerset, N.J. | Union, N.J. |
|---|---|---|---|---|
| County Seat | Morristown | Paterson | Somerville | Elizabeth |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Land Area (Sq. miles) | 468 | 193 | 307 | 103 |
| Population (1950) | 164,371 | 337,093 | 99,052 | 398,138 |
| (1960) | 261,620 | 406,618 | 143,913 | 504,255 |
| est. (1968) | 355,000 | 450,000 | 195,000 | 560,000 |
| Households (1968 est.) | 95,400 | 137,200 | 53,000 | 164,700 |
| Total Retail Trade 1966 ($1000) | 453,614 | 777,274 | 247,217 | 917,899 |
| Shopping Goods Sales 1966 ($1000) | 74,729 | 170,199 | 47,948 | 157,976 |
| Food Store Sales 1966 ($1000) | 131,470 | 185,583 | 74,327 | 215,862 |
| Drug Store Sales 1966 ($1000) | 12,145 | 19,029 | 7,743 | 25,459 |
| Passenger Car Registrations | 134,220 | 190,720 | 62,510 | 259,920 |
| Total Wholesale Trade (1963) ($1000) | 144,986 | 940,841 | 210,240 | 2,159,274 |
| Manufactures: 1963 | | | | |
| Total Employees | 31,332 | 80,599 | 19,224 | 92,414 |
| Value Added ($1000) | 366,430 | 840,620 | 218,378 | 1,275,875 |
| Agriculture: 1964 | | | | |
| Number of Farms | 421 | 120 | 471 | 103 |
| Total Value of Products Sold ($1000) | 6,196 | 1,469 | 7,386 | 3,152 |

Table C-6. New Jersey New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| City | Bridgeport, Conn. | Danbury,Conn. | Fairfield,Conn. | Greenwich,Conn. |
|---|---|---|---|---|
| County | Fairfield | Fairfield | Fairfield | Fairfield |
| Basic Trading Area | Bridgeport,Danbury, Stamford | Bridgeport,Danbury, Stamford | Bridgeport,Danbury, Stamford | Bridgeport, Danbury, Stamford |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 2-A | 3-B | 4-S | 3-S |
| Economic Activity Code | Manufacturing | Manufacturing | D - Suburban | Dm - Suburban & Manufacturing |
| Population: 1960 | 156,748 | 39,382 | 46,183 | 53,793 |
| est. 1968 | 152,000 | 44,500 | 55,500 | 66,000 |
| Households (est. 1968) | 48,100 | 14,200 | 15,600 | 18,500 |
| Total Retail Trade (1966)($1000) | 313,704 | 108,911 | 96,100 | 123,748 |
| Shopping Goods Sales (1966)($1000) | 68,683 | 20,015 | 11,900 | 16,283 |
| Total Wholesale Trade 1963 | 410,514 | 42,303 | 41,876 | 62,558 |
| Manufactures: 1963 | | | | |
| Total Employees | 36,834 | 7,434 | 2,868 | 5,115 |
| Value Added ($1000) | 419,305 | 68,117 | 44,959 | 63,495 |

Table C-7. New Jersey-New York-Connecticut[1]
AIR QUALITY CONTROL REGION

| City | Norwalk, Conn. | Stamford, Conn. | Mt. Vernon, N.Y. | New Rochelle, N.Y. |
|---|---|---|---|---|
| County | Fairfield | Fairfield | Westchester | Westchester |
| Basic Trading Area | Bridgeport, Danbury, Stamford | Bridgeport, Danbury, Stamford | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 3-SS | 2-S | 3-SS | 3-SS |
| Economic Activity Code | Mm(D) - Mfg., Suburban | Mm(D) - Mfg., Suburban | Dm—Suburban Manufacturing | D-Suburban |
| Population: 1960 | 67,775 | 92,713 | 76,010 | 76,812 |
| est. 1968 | 75,500 | 109,500 | 72,000 | 75,000 |
| Households (est. 1968) | 22,900 | 33,000 | 23,300 | 22,300 |
| Total Retail Trade (1966) ($1000) | 126,231 | 226,814 | 142,755 | 156,694 |
| Shopping Goods Sales (1966) ($1000) | 21,932 | 51,140 | 19,514 | 35,273 |
| 1963 Total Wholesale Trade | 61,944 | 201,666 | 269,673 | 114,190 |
| Manufactures: 1963 | | | | |
| Total Employees | 16,428 | 18,350 | 9,536 | 3,816 |
| Value Added ($1000) | 169,052 | 214,606 | 94,395 | 42,175 |

Table C-8. New Jersey-New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| City | New York, N.Y. | White Plains, N.Y. | Yonkers, N.Y. | Bayonne, N.Y. |
|---|---|---|---|---|
| County | New York | Westchester | Westchester | Hudson |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 1-AAAA | 2-S | 2-S | 3-S |
| Economic Activity Code | Mr-Manufacturing, Retail | Mr(D)-Mfg., Retail, Suburban | D-Suburban | Dm - Suburban, Manufacturing |
| Population: 1960 | 7,781,984 | 50,485 | 190,634 | 74,215 |
| est. 1968 | 8,020,000 | 50,040 | 205,000 | 72,000 |
| Households (est. 1968) | 2,737,200 | 16,291 | 64,500 | 22,100 |
| Total Retail Trade (1966) ($1000) | 11,652,474 | 272,472 | 417,190 | 99,155 |
| Shopping Goods Sales (1966) ($1000) | 3,035,118 | 128,383 | 158,563 | 13,173 |
| Total Wholesale Trade: 1963 | 52,929,658 | 397,850 | 226,732 | 65,213 |
| Manufactures: 1963 | | | | |
| Total Employees | 927,413 | 8,387 | 14,701 | 7,709 |
| Value Added ($1000) | 8,861,742 | 27,384 | 148,359 | 108,231 |

Table C-9. New Jersey-New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| City | Bloomfield,N.J. | Cliften,N.J. | East Orange,N.J. | Elizabeth,N.J. |
|---|---|---|---|---|
| County | Essex | Passaic | Essex | Union |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 3-S | 3-S | 3-SS | 2-S |
| Economic Activity Code | Dm - Suburban, Manufacturing | Dm - Suburban Manufacturing | D-Suburban | Mm(D)-Manufacturing, Suburban |
| Population: 1960 | 51,867 | 82,084 | 77,259 | 107,698 |
| est. 1968 | 53,500 | 87,000 | 76,000 | 117,000 |
| Households (est. 1968) | 17,100 | 27,000 | 26,900 | 37,100 |
| Total Retail Trade (1966)($1000) | 71,879 | 125,590 | 126,386 | 213,945 |
| Shopping Goods Sales (1966)($1000) | 10,351 | 9,193 | 22,950 | 41,946 |
| 1968 Total Wholesale Trade | 132,551 | 394,875 | 316,815 | 652,531 |
| Manufactures: 1963 | | | | |
| Total Employees | 9,955 | 18,970 | 3,296 | 19,962 |
| Value Added ($1000) | 99,746 | 221,107 | 24,853 | 210,701 |

Table C-10. New Jersey-New York-Connecticut [1]
AIR QUALITY CONTROL REGION

| City | Hoboken,N.J. | Irvington,N.J. | Jersey City,N.J. | Linden,N.J. |
|---|---|---|---|---|
| County | Hudson | Essex | Hudson | Union |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 3-S | 3-S | 2-S | 4-S |
| Economic Activity Code | Mm(D,T)-Mfg. Sub.,Transpor. | Dm-Suburban, Manufacturing | Dm-Suburban, Manufacturing | Mm(D)-Manufacturing,Suburban |
| Population: 1960 | 48,441 | 59,379 | 276,101 | 39,931 |
| est. 1968 | 47,000 | 60,200 | 267,000 | 43,000 |
| Households (est. 1968) | 15,100 | 21,200 | 85,600 | 12,600 |
| Total Retail Trade (1966) ($1000) | 70,428 | 109,458 | 329,090 | 81,647 |
| Shopping Goods Sales (1966) ($1000) | 8,037 | 14,097 | 50,511 | 5,725 |
| Total Wholesale Trade: 1963 | 93,490 | 69,547 | 597,695 | 361,577 |
| Manufactures: 1963 | | | | |
| Total Employees | 15,089 | 4,312 | 27,227 | 17,829 |
| Value Added ($1000) | 256,759 | 41,473 | 414,837 | 359,386 |

Table C-11. New Jersey-New York-Connecticut[1]
AIR QUALITY CONTROL REGION

| City | | | | |
|---|---|---|---|---|
| County | Essex | Essex | Middlesex | Hudson |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 3-S | 1-B | 3-SS | 4-S |
| Economic Activity Code | D-Suburban | Mm(D) -Mfg., Suburban | Mm(Ed)-Mfg., Education | Mm(D)-Mfg. Suburban |
| Population: 1960 | 43,129 | 405,220 | 40,139 | 42,387 |
| est. 1968 | 44,000 | 385,000 | 40,000 | 42,600 |
| Households (est. 1968) | 13,900 | 121,500 | 12,100 | 14,600 |
| Total Retail Trade (1966) ($1000) | 73,911 | 816,406 | 99,926 | 74,355 |
| Shopping Good Sales (1966) ($1000) | 12,530 | 280,268 | 24,774 | 20,908 |
| 1963 Total Wholesale Trade | 81,795 | 1,865,218 | 101,227 | 62,437 |
| Manufactures: 1963 | | | | |
| Total Employees | 401 | 73,728 | 9,913 | 9,530 |
| Value Added ($1000) | 2,726 | 798,344 | 120,272 | 97,430 |

Table C-12. New Jersey-New York-Connecticut[1] AIR QUALITY CONTROL REGION

| City | Passaic, N.J. | Paterson, N.J. | Plainfield, N.J. | Union, N.J. |
|---|---|---|---|---|
| County | Passaic | Passaic | Union | Union |
| Basic Trading Area | New York City | New York City | New York City | New York City |
| Major Trading Area | New York City | New York City | New York City | New York City |
| Ranally City Rating | 2-S | 2-B | 2-S | 3-S |
| Economic Activity Code | Mm(D) - Mfg., Suburban | Mm(D) - Mfg., Suburban | Dmr-Suburban Mfg., Retail | Dm - Suburban, Manufacturing |
| Population: 1960 | 53,963 | 143,663 | 45,330 | 51,499 |
| est. 1968 | 52,000 | 143,000 | 46,500 | 54,500 |
| Households (est. 1968) | 17,600 | 45,800 | 14,400 | 16,600 |
| Total Retail Trade (1966) ($1000) | 173,051 | 251,072 | 145,331 | 125,496 |
| Shopping Goods Sales (1966) ($1000) | 35,576 | 59,719 | 54,073 | 16,326 |
| 1963 Total Wholesale Trade | 135,087 | 264,036 | 30,932 | 369,359 |
| Manufactures: 1963 | | | | |
| Total Employees | 16,304 | 27,528 | 4,941 | 11,012 |
| Value Added ($1000) | 170,808 | 258,453 | 41,707 | 146,907 |

Table C-13. New Jersey-New York-Connecticut [1] AIR QUALITY CONTROL REGION

| City | Union City, N. J. |
|---|---|
| County | Hudson |
| Basic Trading Area | New York City |
| Major Trading Area | New York City |
| Ranally City Rating | 3-SS |
| Economic Activity Code | Dmr - Suburban, Mfg., Retail |
| Population: 1960 | 52,180 |
| est. 1968 | 50,500 |
| Households (est. 1968) | 18,000 |
| Total Retail Trade (1966) ($1000) | 110,332 |
| Shopping Goods Sales (1966) ($1000) | 31,841 |
| Total Wholesale Trade: 1963 | 51,148 |
| Manufactures: 1963 | |
| Total Employees | 6,656 |
| Value Added ($1000) | 47,764 |

Table C-14 Land Area and Population per Square Mile, by County[2]

1960

| County | Land area (square miles) | Population per square mile |
|---|---|---|
| New York City: | | |
| Bronx | 43 | 33,135 |
| Kings | 76 | 34,570 |
| New York | 22 | 77,195 |
| Queens | 113 | 16,014 |
| Richmond | 60 | 3,700 |
| Other New York: | | |
| Dutchess | 816 | 216 |
| Nassau | 300 | 4,334 |
| Orange | 829 | 222 |
| Putnam | 235 | 135 |
| Rockland | 178 | 769 |
| Suffolk | 922 | 723 |
| Westchester | 435 | 1,960 |
| New Jersey: | | |
| Bergen | 233 | 3,349 |
| Essex | 128 | 7,215 |
| Hudson | 45 | 13,572 |
| Middlesex | 312 | 1,391 |
| Monmouth | 477 | 701 |
| Morris | 467 | 560 |
| Passaic | 194 | 2,096 |
| Somerset | 307 | 469 |
| Union | 103 | 4,896 |
| Connecticut: | | |
| Fairfield | 633 | 1,033 |

Source: U. S. Department of Commerce, Bureau of the Census.

Table C-15 Place of Work of
Nassau and Suffolk Counties' Resident Labor Force [2]

1960

| Place of work | Nassau | Percent | Suffolk | Percent |
|---|---|---|---|---|
| Bronx | 3,526 | 0.8% | 728 | 0.3% |
| Kings | 28,716 | 6.1 | 5,677 | 2.7 |
| New York | 107,965 | 23.1 | 17,098 | 8.0 |
| Queens | 41,867 | 9.0 | 9,287 | 4.4 |
| Richmond | 79 | - | 16 | 0.0 |
| New York City (not further specified) | 546 | 0.1 | 775 | 0.4 |
| New York City | 182,699 | 39.1% | 33,581 | 15.8% |
| Nassau | 248,409 | 53.2% | 29,982 | 14.1% |
| Suffolk | 13,459 | 2.9 | 136,077 | 63.9 |
| Rockland | 60 | - | 8 | 0.0 |
| Westchester | 1,331 | 0.3 | 270 | 0.1 |
| Other | 5,030 | 1.1 | 1,305 | 0.6 |
| Place of work not reported | 16,235 | 3.5 | 11,594 | 5.4 |
| ToTotal | 467,223 | 100.0% | 212,817 | 100.0% |

Source: U. S. Department of Commerce, Bureau of the Census.

Table C-16

New York State Counties
with
*Population Greater than 60,000 and
Population Density Greater than 25 per sq. mi. [3]

| County | Population Rank | Population Total | Density Rank | Density Population per sq. mi. |
|---|---|---|---|---|
| Albany | 7 | 286,647 | 9 | 540 |
| Broome | 10 | 223,268 | 11 | 314 |
| Cattaraugus | 24 | 80,336 | 28 | 60 |
| Cayuga | 26 | 75,815 | 23 | 108 |
| Chautaugua | 14 | 150,090 | 18 | 139 |
| Chemung | 20 | 101,796 | 14 | 247 |
| Clinton | 25 | 77,918 | 25 | 74 |
| Dutchess | 11 | 215,042 | 12 | 264 |
| Erie | 2 | 1,088,295 | 5 | 1,033 |
| Herkimer | 30 | 69,722 | 29 | 48 |
| Jefferson | 23 | 88,945 | 27 | 69 |
| Monroe | 5 | 655,892 | 6 | 975 |
| Nassau | 1 | 1,435,850 | 1 | 4,786 |
| Niagara | 9 | 242,373 | 10 | 455 |
| Oneida | 8 | 279,597 | 15 | 228 |
| Onondaga | 6 | 470,517 | 8 | 594 |
| Ontario | 28 | 74,731 | 22 | 115 |
| Orange | 12 | 214,430 | 13 | 259 |
| Oswego | 22 | 92,994 | 24 | 96 |
| Rensselaer | 16 | 148,308 | 16 | 223 |
| Rockland | 13 | 204,168 | 3 | 1,147 |
| St. Lawrence | 18 | 117,964 | 30 | 43 |
| Saratoga | 19 | 103,892 | 19 | 128 |
| Schenectady | 15 | 148,348 | 7 | 710 |
| Steuben | 21 | 100,271 | 26 | 71 |
| Suffolk | 3 | 1,004,379 | 4 | 1,089 |
| Tompkins | 29 | 73,845 | 17 | 150 |
| Ulster | 17 | 139,453 | 21 | 122 |
| Wayne | 27 | 75,111 | 20 | 124 |
| Westchester | 4 | 869,021 | 2 | 1,998 |

30 Counties with a total population of 8,909,018

Population in New York City (estimated as of July 1, 1968)

| | |
|---|---|
| NEW YORK CITY | 8,125,000 |
| Manhattan | 1,750,000 |
| Bronx | 1,470,000 |
| Brooklyn | 2,650,000 |
| Queens | 1,985,000 |
| Richmond | 270,000 |

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* Based on 1967 population, estimated as of July 1, 1967

Table C-17

New York State Counties
with *Population less than 60,000 and
Population Density greater than 25 per sq. mile

| County | Population Rank | Population Total | Density Rank | Density Population per sq. mile |
|---|---|---|---|---|
| Allegany | 16 | 43,166 | 4 | 41 |
| Chenango | 11 | 46,408 | 7 | 51 |
| Columbia | 6 | 50,052 | 15 | 78 |
| Cortland | 15 | 43,877 | 17 | 87 |
| Delaware | 17 | 42,420 | 2 | 29 |
| Franklin | 14 | 44,099 | 1 | 26 |
| Fulton | 5 | 50,869 | 20 | 102 |
| Genesee | 2 | 58,544 | 22 | 117 |
| Greene | 21 | 33,160 | 8 | 51 |
| Livingston | 8 | 48,675 | 14 | 76 |
| Madison | 1 | 59,522 | 18 | 90 |
| Montgomery | 3 | 53,977 | 23 | 132 |
| Orleans | 18 | 37,855 | 19 | 96 |
| Otsego | 4 | 53,801 | 9 | 53 |
| Putnam | 12 | 46,289 | 24 | 908 |
| Schoharie | 22 | 22,184 | 3 | 35 |
| Schuyler | 24 | 15,687 | 5 | 47 |
| Seneca | 20 | 34,275 | 21 | 104 |
| Sullivan | 9 | 48,205 | 6 | 49 |
| Tioga | 13 | 44,629 | 16 | 85 |
| Warren | 10 | 47,661 | 10 | 54 |
| Washington | 7 | 49,382 | 12 | 59 |
| Wyoming | 19 | 36,170 | 13 | 60 |
| Yates | 23 | 18,953 | 11 | 55 |

* Based on 1967 population, estimated as of July 1, 1967

Table C-18

New York State Counties
with *Populations less than 60,000 and
Population Density less than 25 per sq. mile 3

| County | Population Rank | Population Total | Density Rank | Density Population per sq. mile |
|---|---|---|---|---|
| Essex | 1 | 34,883 | 1 | 19 |
| Hamilton | 3 | 4,316 | 3 | 2 |
| Lewis | 2 | 23,553 | 2 | 18 |

3 Counties with a total population of 62,752

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* Based on 1967 population, estimated as of July 1, 1967

References for Appendix C.

1. Rand McNally Commercial Atlas and Marketing Guide, 99th ed., Chicago: Rand McNally and Company, 1968.

2. Griffin, John I., and Namis, Jean; Fact Book: New York Metropolitan Region; New York: New York City Council on Economic Education, 1965

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* U. S. GOVERNMENT PRINTING OFFICE : 1970—436-613/47 3)